السيد / مدير عام الهيئة العامة للطرق والنقل البري **المحترم،،**

ص.ب 8 الكويت الصفاة13001
هاتف:25304000 فاكس:25390829

تحية طيبة وبعد ،،،

الموضوع :العقد رقم : هـ . ط/140 تصميم وإنشاء وانجاز وصيانة جسر الشيخ / جابر الأحمد الصباح (الجسر الرئيسي – وصلة الصبية)
بخصوص: المحطات الفرعية 11ك.ف (Bss-1 & Bss-2)

بالإشارة الموضوع أعلاه ، والى كتابكم رقم :16-4/2375 بتاريخ 2017/12/20 بخصوص اعتماد السادة / شركة البناء والتعمير العقارية (ريكافكو) لتنفيذ انشاء محطات الثانوية للمشروع أعلاه ، نود إفادتكم بأن الشركة قد نفذت محطات سابقة لدى وزارة الكهرباء والماء ولها عقد جاري حالياً بنفس الخصوص وعليه لا مانع من اعتماد الشركة كمقاول لتنفيذ المحطات الثانوية ، مع العلم بأن مسئولية التصميم الانشائي للمحطات المراد تنفيذها تقع على الاستشاري المصمم والشركة المنفذة .

مع أطيب التمنيات ،،،

وكيل وزارة الكهرباء والماء

نسخة إلى:
السيد : الوكيل المساعد لشبكات التوزيع الكهربائية
السيد : مدير إدارة شبكات التوزيع الكهربائية
السيد : رئيس قسم الأعمال المدنية

المهندس
عبد المحسن علي الصراف
رئيس قسم الأعمال المدنية

REF :
DATE :

الإشارة : ٢٣٧٥ -٤/١٢
التاريخ : ١٧/١٢/٢٠١٧

المحترم
السيد/ وكيل وزارة الكهرباء والماء
المحترم
عناية/ قطاع شبكات التوزيع الكهربائية (المهندس/ خالد مونس العنزي)

تحية طيبة وبعد،،،

الموضوع : العقد هـ ط /140
تصميم وإنشاء وإنجاز وصيانة جسر الشيخ/ جابر الأحمد الصباح
(الجسر الرئيسي - وصلة الصبية)
بخصوص : المحطات الفرعية 11 ك.ف. (BSS-1 & BSS-2)

بالإشارة إلى الموضوع أعلاه، وإلى كتابكم رقم (و.ك.م/25109/7) بتاريخ 2017/09/11، بخصوص إعتماد المخططات للمحطات الفرعية 11 ك.ف. (BSS-1 & BSS-2) للعقد المذكور أعلاه -مرفق نسخة.
يرجى التكرم بالإحاطة والعلم بأن كتابكم المشار إليه أعلاه قد تضمن اعتماد المخططات المعمارية فقط علماً بأن كتابنا الموجه إليكم لطلب الاعتماد اشتمل على المخططات المعمارية والإنشائية للمحطات الفرعية 11 ك.ف. (BSS-1 & BSS-2)، هذا وقد تم الاستفسار من السادة/ ممثليكم عن سبب إعتماد المخططات المعمارية فقط دون المخططات الإنشائية، حيث تم الإفادة أن مسئولية التصميم الإنشائي تقع على عاتق المورد المعتمد لتصنيع وتوريد أعمال الخرسانة سابقة الصب والتي تشكل طريقة إنشاء المحطات.
وبهذا الصدد، نرفق لكم نسخة من كتاب مقاول العقد رقم RA140-DAH-HD-17-2551 بتاريخ 14 نوفمبر 2017 والمرفق به السيرة الذاتية للسادة/ شركة البناء والتعمير العقارية (ريكافكو)- مرفق رقم (1).
يرجى التكرم بالإيعاز لمن يلزم من قبلكم نحو دراسة اعتماد الشركة المذكورة لأعمال تصنيع وتوريد وحدات الخرسانة سابقة الصب للمحطات الفرعية 11 ك.ف. للمشروع، شاكرين لكم حسن تعاونكم.
لمزيد من الاستفسار يرجى الاتصال على مهندس المشروع - م/ مي المسعد - نقال 99621258 أو مهندس الموقع - م/ فؤاد المسري - نقال 99480008.

وتفضلوا بقبول فائق الاحترام والتقدير،،،

مدير عام الهيئة العامة للطرق والنقل البري

المرفقات: كما هو مذكور أعلاه.

وزارة الكهرباء والماء

MINISTRY OF ELECTRICITY & WATER

كويت جديدة
NEWKUWAIT

الإشارة Ref: ٥٠١٠٩ / ٧٢٠١٩

التاريخ Date: ١٧/٩/١١

الموافق : .....

السيد / وكيل وزارة الأشغال العامة المحترم,,,

تحية طيبة وبعد ،،،

الموضوع : العقد رقم : هـ.ط/140 تصميم وإنشاء وانجاز وصيانة جسر

الشيخ / جابر الأحمد الصباح (الجسر الرئيسي – وصلة الصبية)

المحطات الفرعية 11 ك .ف (BSS2) – (BSS1)

بالإشارة إلى كتابكم رقم : 3022-29-4/16 بتاريخ 2017/07/30 بخصوص الموضوع أعلاه . مرفق طيه المخططات المعمارية المعتمدة للمحطتين BSS2 , BSS1 مع مراعاة ماجاء بهما من ملاحظات باللون الأحمر . ويرجى إفادتنا رسمياً بعد الإنتهاء من التنفيذ للاستلام وعمل اللازم ولأى استفسار يرجى مراجعة قسم الأعمال المدنية / هاتف :25732361 .

مع أطيب التمنيات ،،،

وكيل وزارة الكهرباء والماء

١٧/٩/١٠

وزارة الأشغال العامة
إدارة الخدمات الإدارية
(المركز الداخلي)
المرجع ٢٩
التسلسل ٤٧٣٨
التاريخ ٢٠١٧/٩/١٢

وزارة الأشغال العامة
إدارة الطرق السريعة والجسور
سجل الوارد
الرقم ٤٩١٩
التاريخ ٢٠١٧/٩/١٣

٧٩٢٩
١٧ ٩ ١٢

صحا ١٧/٩/١٢

الإشارة : ٤/١٦ - ٢٩ - ٣٠٢٢
التاريخ : ٣٠ يونيو ٢٠١٧

REF :
DATE :

السيد / وكيل وزارة الكهرباء والماء المحترم

عناية/ قطاع شبكات التوزيع الكهربائية (المهندس/ خالد مونس العنزي) المحترم

تحية طيبة وبعد،،،

الموضوع : العقد هـ ط/140

تصميم وإنشاء وإنجاز وصيانة جسر الشيخ/ جابر الأحمد الصباح

(الجسر الرئيسي – وصلة الصبية)

بخصوص : تقديم المخططات المعمارية والإنشائية وحسابات التصميم للهيكل الخرساني مُسبق الصب للمحطات الفرعية 11 ك.ف BSS-1 و BSS-2 لاعتماد وزارة الكهرباء والماء

بالإشارة إلى الموضوع أعلاه، وإلى كتاب مقاول العقد تحالف (شركة هيونداي – شركة المجموعة المشتركة للمقاولات) رقم RA140-DAH-HD-17-2334 بتاريخ 2017/07/18، المتضمن طلبه تقديم المخططات المعمارية والإنشائية وحسابات التصميم للهيكل الخرساني مُسبق الصب للمحطات الفرعية 11 ك.ف BSS-1 و BSS-2 – **مرفق نسخة.**

بناءاً عليه، يرجى التكرم بالإيعاز لمن يلزم من قبلكم نحو دراسة وإعتماد المخططات والحسابات المرفقة، وذلك بالسرعة الممكنة حتى نتمكن من عمل اللازم، شاكرين لكم حسن تعاونكم.

لمزيد من الاستفسار يرجى الاتصال على مهندس المشروع – م/ مي المسعد – نقال 99621258 أو مهندس الموقع – م/ فؤاد المسرى – نقال 99480008.

وتفضلوا بقبول فائق الاحترام والتقدير،،،

وكيل وزارة الأشغال العامة

المهندس/ حسام بدر الطاحوس
الوكيل المساعد لقطاع المشاريع الكبرى

وزارة الكهرباء والماء
إدارة السجل العام
قسم الوارد (3)
الرقم ٣٢٣٧٩٩
الاشارة
التاريخ ٢٠١٧/

المرفقات:

1) المخططات المعمارية والإنشائية للمحطة BSS-1 (1 مجموعة قياس A1 ومجموعة قياس A3).
2) المخططات المعمارية والإنشائية للمحطة BSS-2 (1 مجموعة قياس A1 ومجموعة قياس A3).
3) حسابات التصميم (1 مجموعة قياس A4)
4) نسخة إلكترونية (أسطوانة)

HYUNDAI ENGINEERING & CONSTRUCTION

HYUNDAI-CGC CONSORTIUM

Combined Group Contracting Company

P.O.Box :24314, SAFAT-13104, Kuwait
Tel : + 965 2228 2250/51/52/53
Fax : +965 2228 2254

P.O.Box 4819, SAFAT 13049, Kuwait
Tel : +965 2225 4545
Fax : +965 2434 4610

Dar Al-Handasah Consultants
(Shair and Partners)

Salwa Area 10
St. No. 7, Villa No.4
P.O Box 1938, Safat 13020 / State of Kuwait

دار الهندسة للاستشارات الهندسية
(شاعر ومشاركوه)

سلوي- قطعة 10
شارع رقم 7 ، منزل رقم 4
صندوق بريد 1938 ، الصفاة 13020/ دولة الكويت

Date : 18 July 2017
Ref No : RA140-DAH-HD-17- 2334

التاريخ : 18 يوليو 2017
رقم الإشارة: RA140-DAH-HD-17-2334

Attention: Eng. Joo Ho Lee
Supervision Manager / Chief Resident Engineer

عناية المهندس/ جو هو لي المحترم،
مدير الإشراف، المهندس المقيم الرئيسي

Project : Design, Build, Completion and Maintain
Sheikh Jaber Al-Ahmad Al-Sabah
Causeway Project (Main Link)
Contract NO. RA/140

الموضوع: تصميم وإنشاء وإنجاز وصيانة
جسر الشيخ / جابر الأحمد الصباح
(الجسر الرئيسي)
رقم العقد : هـ ط/140

Subject: **Submission of Architectural, Structural Drawings and Design Calculations for Precast Concrete Structure of the 11kV Substations BSS-1 & BSS-2 for MEW approval**

تقديم المخططات المعمارية والانشائية وحسابات التصميم للهيكل الخرساني مسبق الصب للمحطات الفرعية 11 ك ف BSS-1 و BSS-2 لاعتماد وزارة الكهرباء والماء

Dear Sirs,

تحية طيبة وبعد،

With reference to the subject above, we are pleased to submit the architectural, structural drawings and design calculations for precast concrete structure of the 11kV Substations BSS-1 & BSS-2 for MEW approval.

بالإشارة إلى الموضوع أعلاه، نرفق لسيادتكم المخططات المعمارية والانشائية وحسابات التصميم للهيكل الخرساني مسبق الصب للمحطات الفرعية 11 ك ف BSS-1 و BSS-2 لاعتماد وزارة الكهرباء والماء.

In this regard, you are kindly requested to coordinate with MPW to forward the attached drawings (1 set of A1 size & 1 set of A3 size) and design calculations (1 set of A4 size) to MEW Civil Dept. for their review and approval.

وبهذا الشأن، نرجو التكرم بالتنسيق مع السادة وزارة الأشغال العامة وتقديم المخططات المرفقة (1 مجموعة قياس A1 و 1 مجموعة قياس A3) وحسابات التصميم (1 مجموعة قياس A4) سادة وزارة الكهرباء والماء، إدارة الأعمال المدنية للمراجعة والاعتماد.

We also request to share with us the MEW receipt copy of submission letter for our record and follow up.

كما نرجو موافاتنا بنسخة ما يفيد باستلام وزارة الكهرباء والماء للتقديم وذلك للتسجيل والمتابعة.

Assuring you of our best attention at all times, we remain.

نؤكد اهتمامنا التام في جميع الأوقات،

Sincerely yours,

وتفضلوا بقبول فائق الاحترام والتقدير ،

RECEIVED
18 JUL 2017
Dar Al-Handasah

Joong Ho Song / Project Director
For and on behalf of Hyundai-CGC Consortium

جون هو سونج/ مدير المشروع
نيابة عن تحالف شركة هيونداي – شركة المجموعة المشتركة للمقاولات

Encl.:
1) Substation BSS-1 architectural, structural drawings (1 set of A1 size & 1 set of A3 size for MEW and 2 sets of A3 size for ER/MPW)
2) Substation BSS-2 architectural, structural drawings (1 set of A1 size & 1 set of A3 size for MEW and 2 sets of A3 size for ER/MPW)
3) Design Calculations (1 sets of A4 size for MEW & 2 sets of A4 size for ER/MPW)
4) CD soft file (1 copy each for ER/MPW/MEW)

المرفقات: 1) المخططات المعمارية والانشائية للمحطة BSS-1 (1 مجموعة A1 ومجموعة A3 لوزارة الكهرباء و 2 مجموعة قياس A3 لدار الهندسة ووزارة الأشغال)
2) المخططات المعمارية والانشائية للمحطة BSS-2 (1 مجموعة A1 ومجموعة A3 لوزارة الكهرباء و 2 مجموعة قياس A3 لدار الهندسة ووزارة الأشغال)
3) حسابات التصميم (1 مجموعة قياس A4 لوزارة الكهرباء والماء وعدد 2 مجموعة A4 لممثل المهندس/وزارة الأشغال العامة)
4) نسخة الكترونية (أسطوانة) (عدد 1 أسطوانة لكل من ممثل المهندس/وزارة الأشغال العامة/ وزارة الكهرباء والماء)

C.C.: MPW - RA140 Project Engineer

نسخة إلى: وزارة الأشغال العامة- السيدة/ مهندسة المشروع

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

ADMINISTRATION & FACILITY BUILDINGS - ARCHITECTURE
SUBSTATION BSS-1 (NORTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-AR-DW-63540-C1

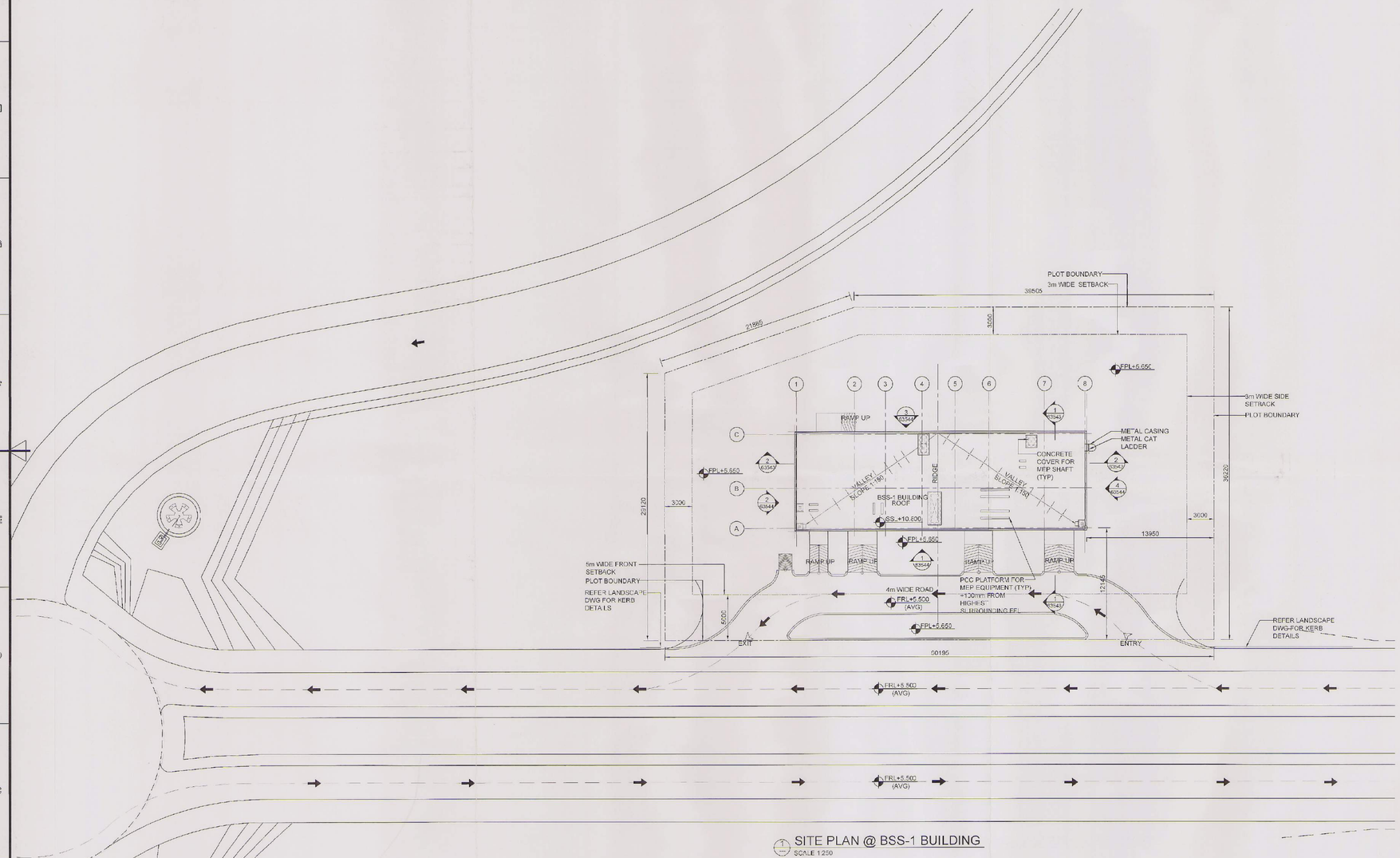
Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-AR-DW-63541	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	SITE PLAN	
RA140-32-BUI-AR-DW-63542	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT – GROUND FLOOR PLAN	
RA140-32-BUI-AR- DW-63543	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT SECTION	
RA140-32-BUI-AR-DW-63544	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT - ELEVATIONS	
RA140-32-BUI-AR-DW-63545	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FLOORING LAYOUTS	
RA140-32-BUI-AR-DW-63546	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	REFLECTED CEILING PLAN	
RA140-32-BUI-AR-DW-63547	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	MISCELLANEOUS DETAILS	
RA140-32-BUI-AR-DW-63548	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT – ROOF PLAN	

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
FGL	FINISH GROUND LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	INGRESS/ EGRESS/ ENTRY/ EXIT
℄	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER LANDSCAPE DWGS
	SITE BOUNDARY



1 SITE PLAN @ BSS-1 BUILDING
SCALE 1:250

NORTH DIRECTION AT BAY ISLAND NORTH

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	HSH		BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
NORTH ISLAND
SUBSTATION (BSS-1)
SITE PLAN

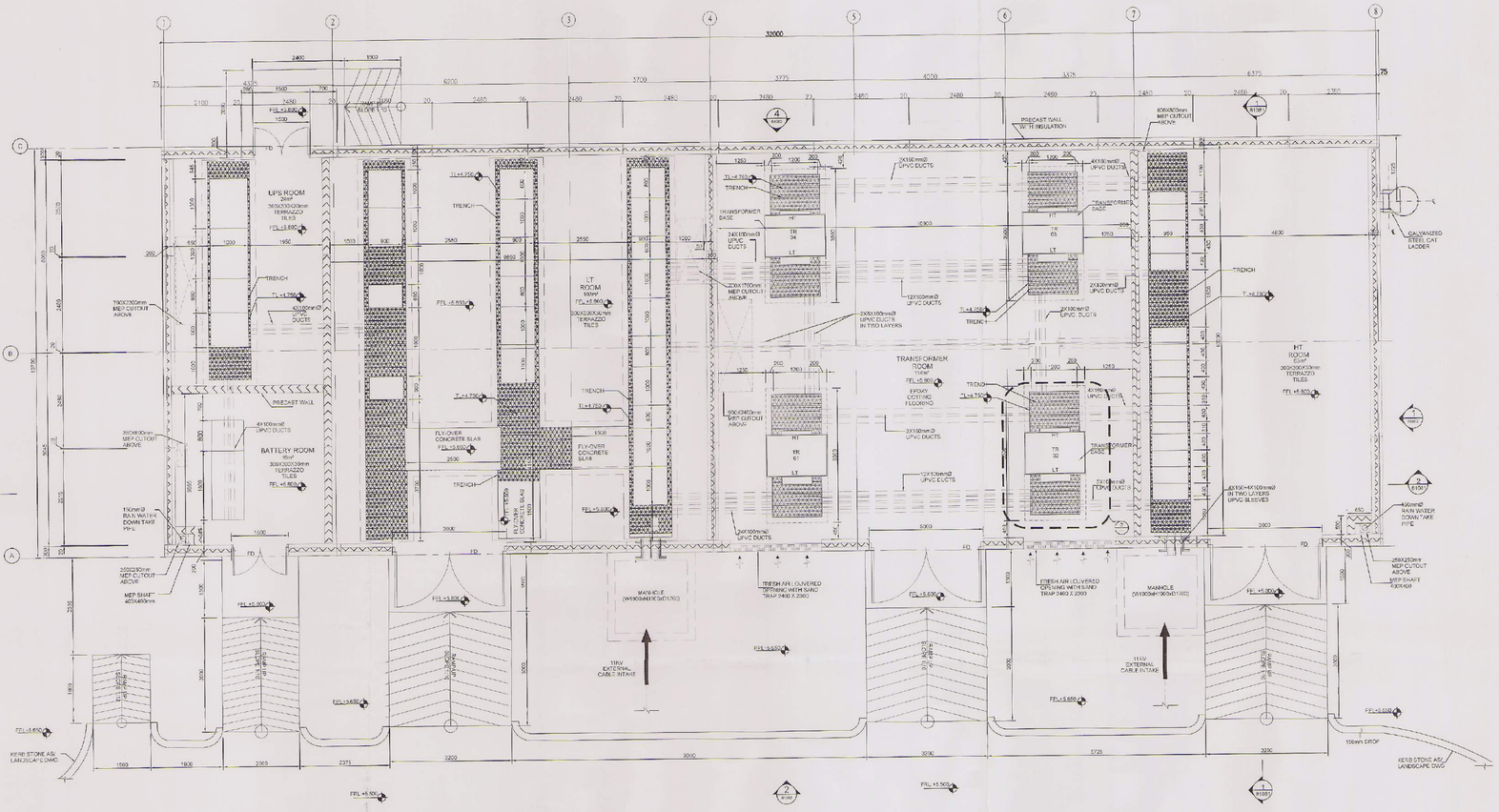
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63541

REV.
C1

A1(594x841mm ±2mm)



SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	SCREED
	ROD
FRESH AIR LOUVERED OPENING WITH SAND TRAP 2400X2300	
	TRENCH COVER
PRECAST WALL & ROOF	

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE 'HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHEQUERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 8mm CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL COORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR ACCESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT).
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL BLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. COORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO M.I.P.S SHALL NOT EXCEED 30 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY ON INSIDE.
20. ALL DOORS ARE STEEL DOORS AS MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	30.07.17	FOR CONSTRUCTION	E.L.	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN.& FACILITY BUILDINGS- ARCHITECTURE
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - GROUND FLOOR PLAN

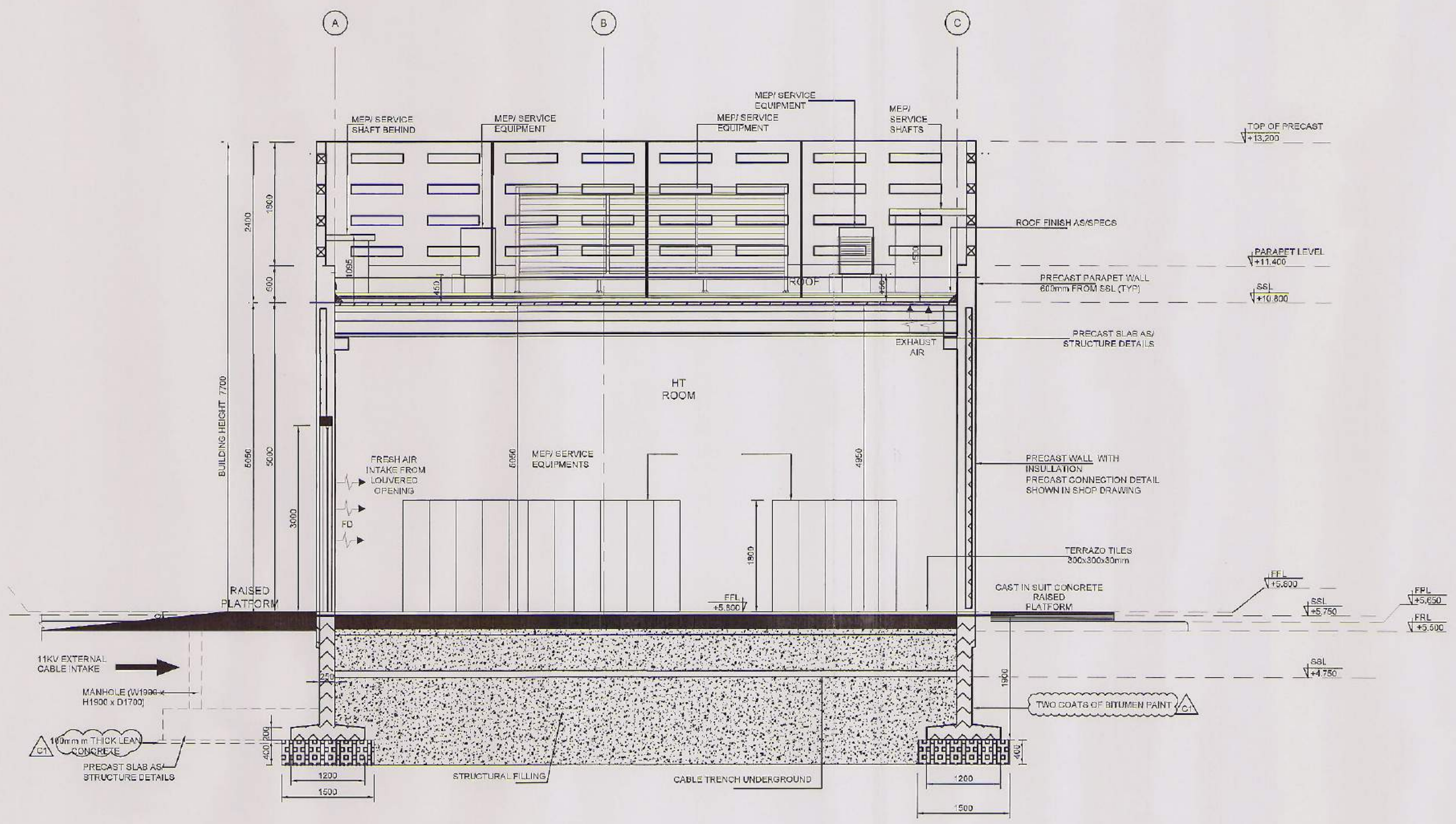
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	E.L	BCP	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

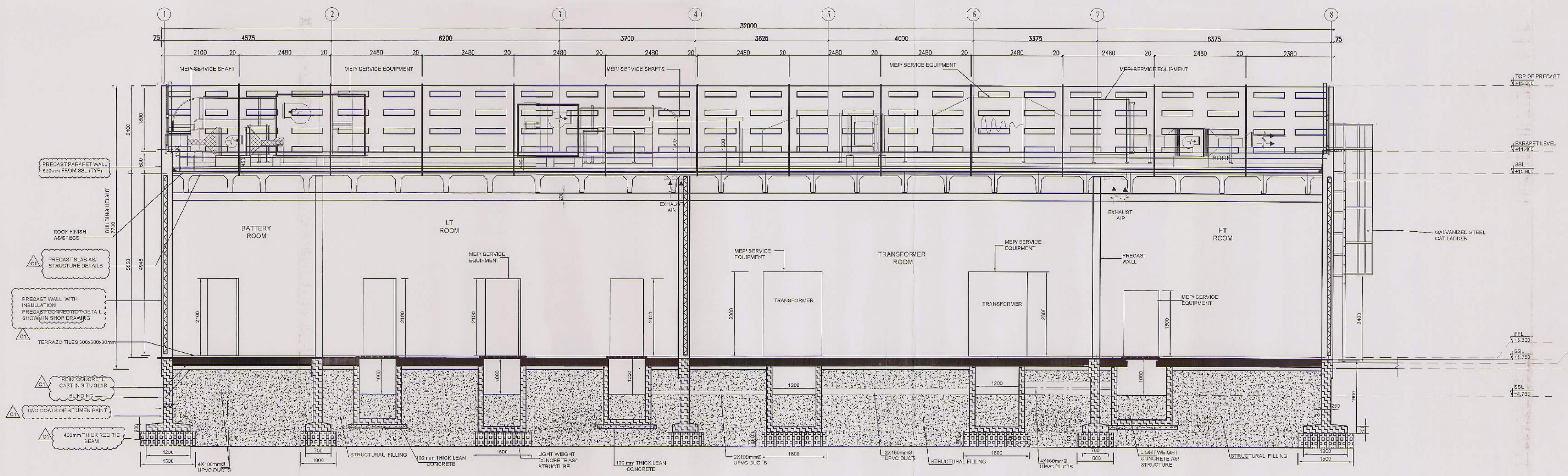
HYUNDAI ENGINEERING & CONSTRUCTION | Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-63542 | REV. C1

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال الهندسية



SECTION



SECTION

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	FILLING AS / STRUCTURE
	SCREED
	RCC
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION
	TRENCH COVER
	BLOCK WORK
	RCC TIE BEAM
	LEAN CONCRETE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
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16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS/ MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN. &FACILITY BUILDING - ARCHITECTURE
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - SECTIONS

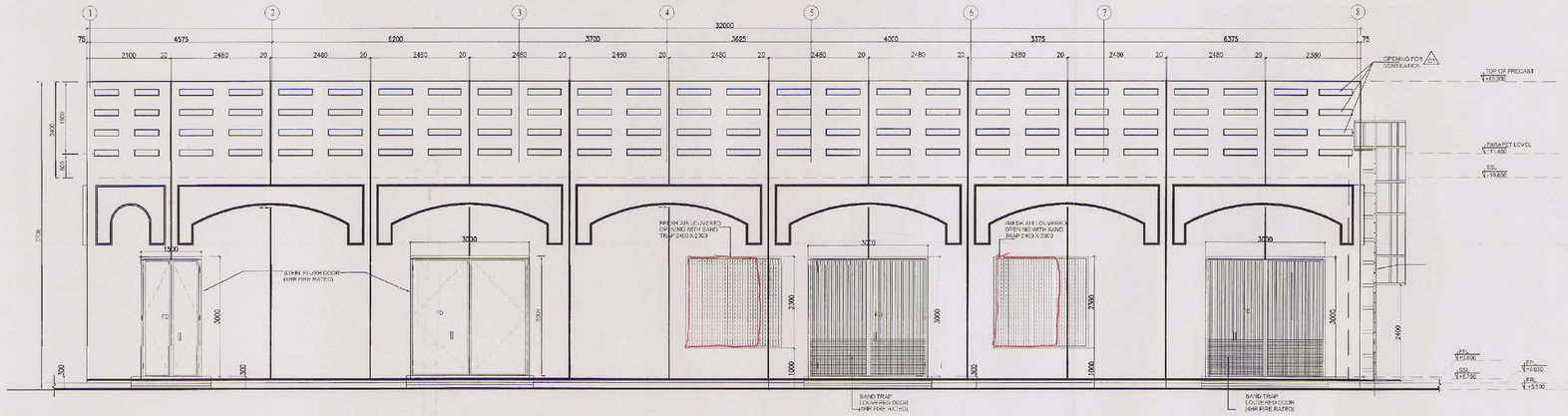
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

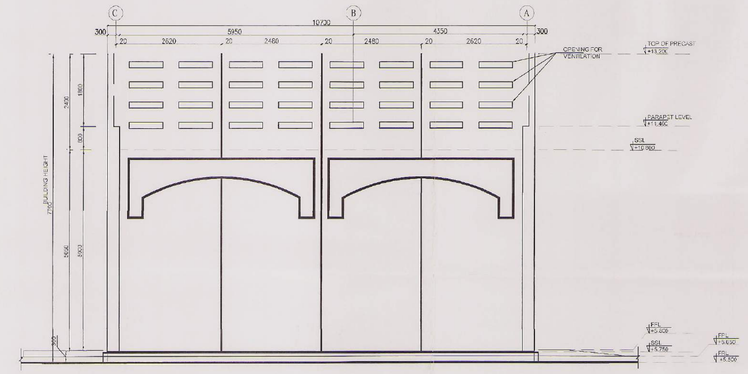
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-63543

REV. C1



ELEVATION
SCALE - 1:50



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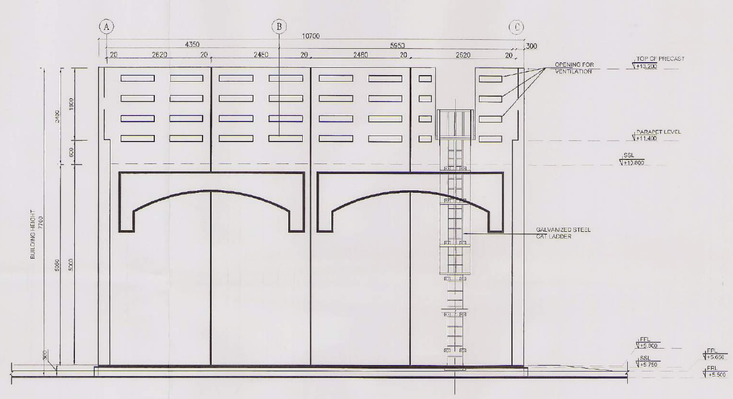

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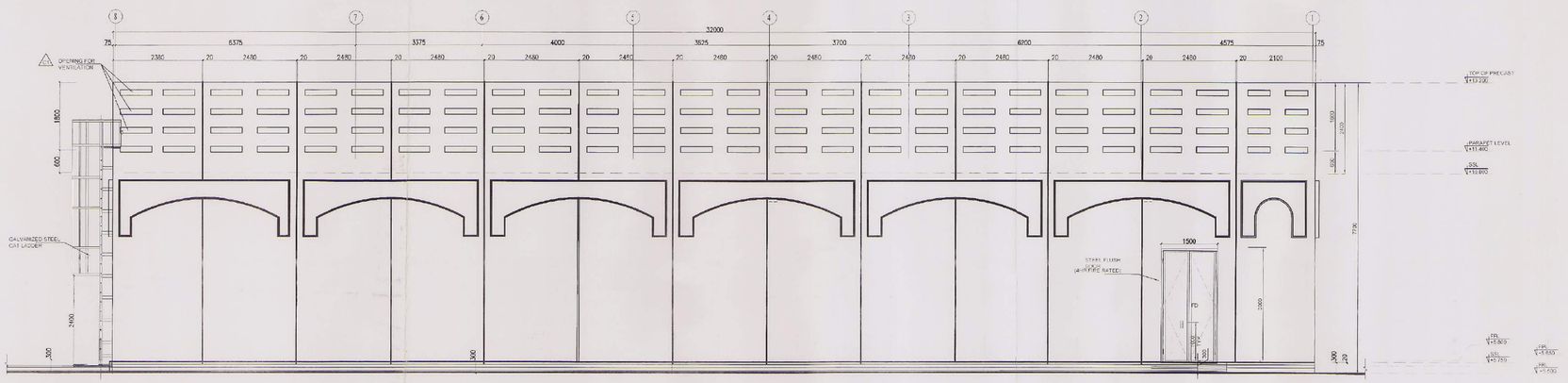

ELEVATION
SCALE - 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FSL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED
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7. THE SUB STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 210mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB STATION WORK IN ALL RESPECTS
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL BUSHES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
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20. ALL DOORS ARE STEEL DOORS AS PER REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.
22. ALL WALLS ARE INSULATED.

وزارة الكهرباء والماء
إدارة شبكات النوازل الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

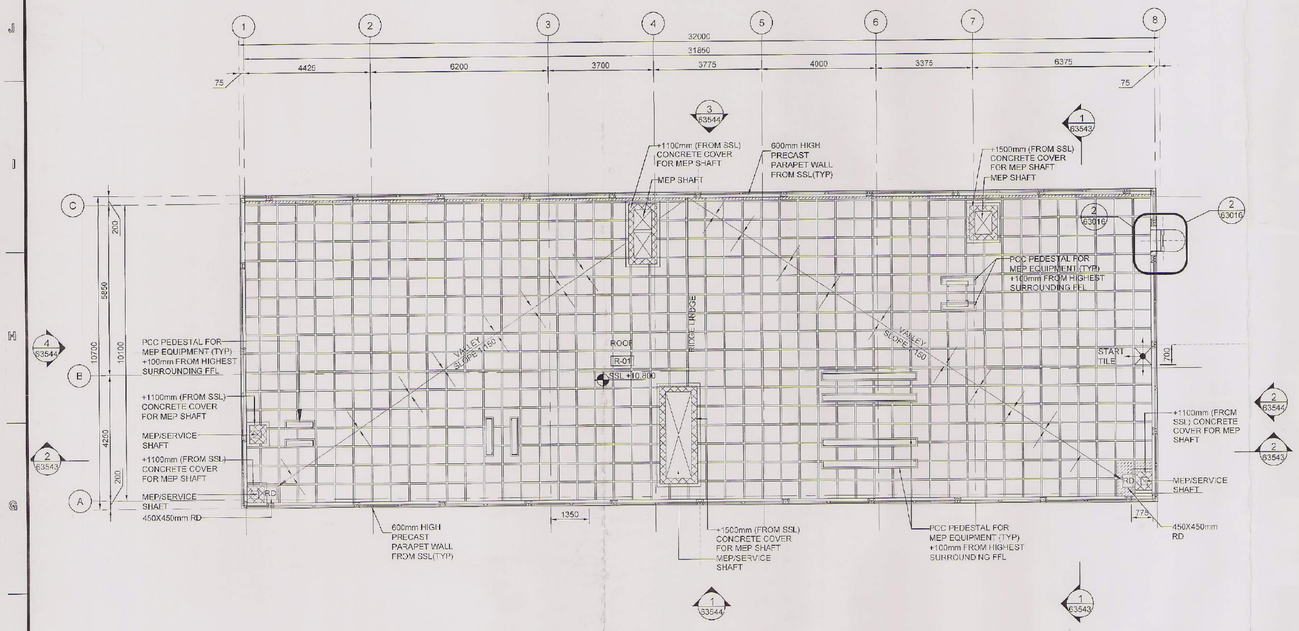
DRAWING TITLE
ADMIN. &FACILITY BUILDING - ARCHITECTURE
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - ELEVATIONS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISS. 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

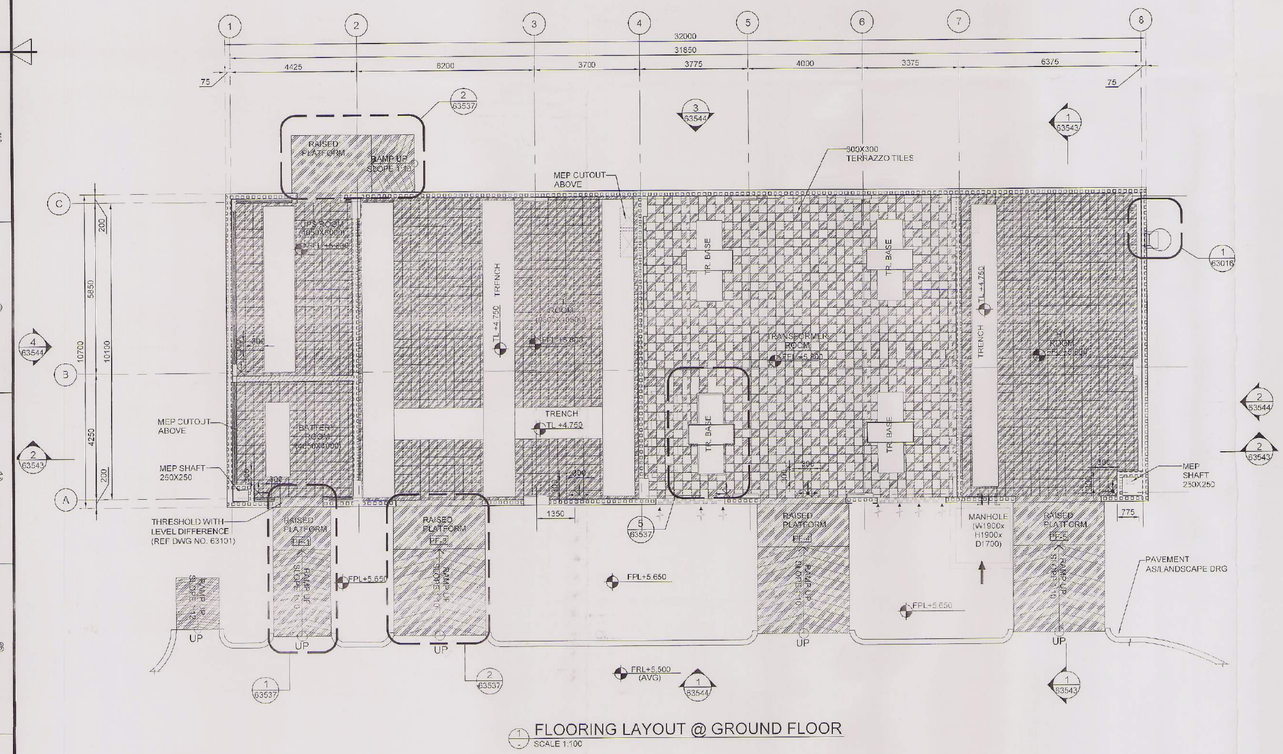
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63544

REV.
C1



2 FLOORING LAYOUT @ ROOF
SCALE 1:100



1 FLOORING LAYOUT @ GROUND FLOOR
SCALE 1:100

FLOORING LEGEND

F5		KOTA STONE FLOORING TILE SIZE = 600mm X 600mm
F7 + T2		RCC SLAB FINISHED WITH CONCRETE TILE
F11		TERRAZZO TILES SIZE = 300mm X 300mm X30mm
		START TILE
		FLOOR FINISH WITH EPOXY COTTING

GENERAL NOTES

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2. HT ROOM, TRANSFORMER ROOM AND LT ROOMS ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
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7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHEQERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
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15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
√	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
NORTH ISLAND
SUBSTATION (BSS-1)
FLOORING PLANS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

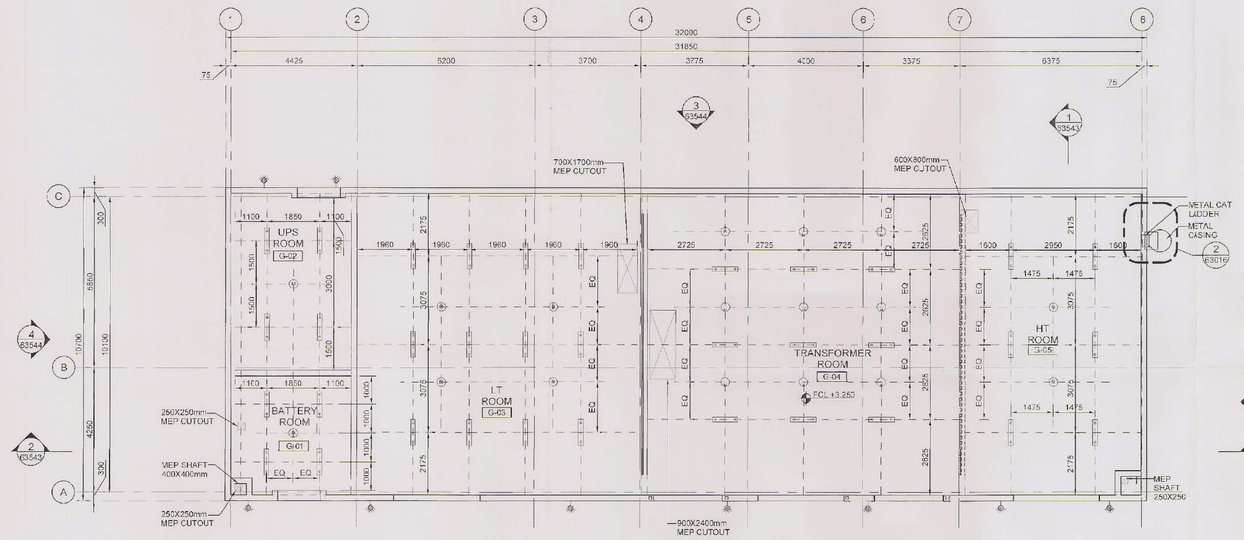
HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

NORTH DIRECTION AT BAY ISLAND NORTH

DRAWING NO. RA140-32-BUI-AR-DW-63545

REV. C1

A1(594x841mm +2mm)



REFLECTED CEILING PLAN @ GROUND FLOOR
SCALE 1:100

SHEETS NOTES

1. ALL FINISHED FALSE CEILING LEVELS ARE FROM THE RESPECTIVE FINISHED FLOOR LEVEL (FFL)
2. ALL SPACES WHERE RCC WITH INTERIOR GRADE PLASTER & PAINT FINISH AS/SPECIFICATIONS IS MARKED, SHALL NOT HAVE ANY FALSE CEILING.
3. ALL TYPES OF FALSE CEILINGS SHALL BE INSTALLED AS PER SPECIFICATIONS.
4. WHEREVER GYPSUM BOARD CEILING IS USED IN ANY WET AREA IT SHALL BE MOISTURE RESISTENT GYPSUM BOARD ONLY.
5. ALL MEP FIXTURES IN ROOMS WITH CEILING TILES SHALL BE LOCATED IN CENTRE OF TILE.

HVAC LEGEND	
SYMBOL	DESCRIPTION
	SUPPLY AIR DIFFUSER
	RETURN AIR DIFFUSER
	D.SC VALVE EXHAUST
	ACCESS PANEL
	CASSETTE UNIT
FIRE FIGHTING LEGEND	
	PENDENT SPRINKLER HEAD
H	HEAT DETECTOR
RI	RESPONSE INDICATOR WITH TWIN HIGH INTENSITY LEDS
	NOZZLE (360°-FEMALE THREADED) (ROOM & CEILING VOID)
M	MULTI SENSOR OPTICAL SMOKE THERMISTOR BASED CUM HEAT DETECTOR
S	SMOKE DETECTOR
ELECTRICAL LEGEND	
	4x14W FLUORESCENT FIXTURE RECESS TYPE
	4x14W FLUORESCENT FIXTURE RECESS TYPE
	2x18 W CFL RECESS MOUNTED DOWN LIGHTER
	2x28W SUSPENDED MOUNTED LIGHT FIXTURE
	2x28W RECESS MOUNTED LIGHT FIXTURE
	2x26W CFL RECESS MOUNTED DOWN LIGHTER
	2x16W CFL SURFACE MOUNTED DOWN LIGHT FIXTURE
	HIGH WALL UNIT (DU)
150	PRECISION AIR CONDITIONING INDOOR UNIT
	SQUARE SUPPLY GRILLE
	SQUARE RETURN GRILLE / EXHAUST GRILLE

GENERAL NOTES

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SYMBOL LEGEND

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REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
NORTH ISLAND
SUBSTATION (BSS-1)
REFLECTED CEILING PLAN

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

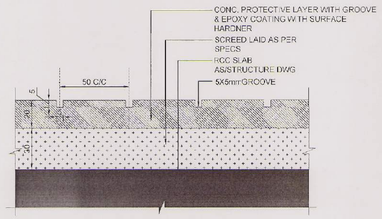
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

NORTH DIRECTION AT BAY ISLAND NORTH

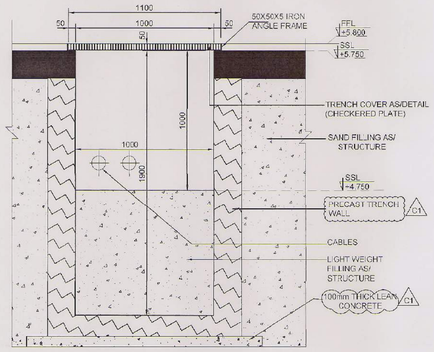
DRAWING NO. RA140-32-BUI-AR-DW-63546

REV. C1

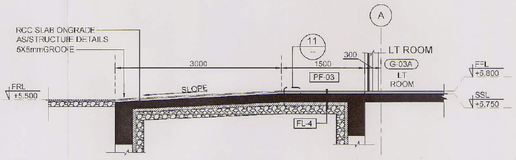
A1(594x841mm +2mm)



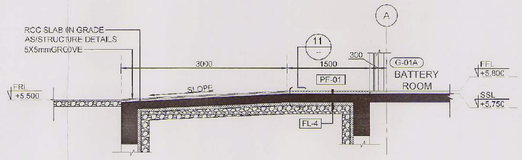
11 DETAIL
SCALE 1:2



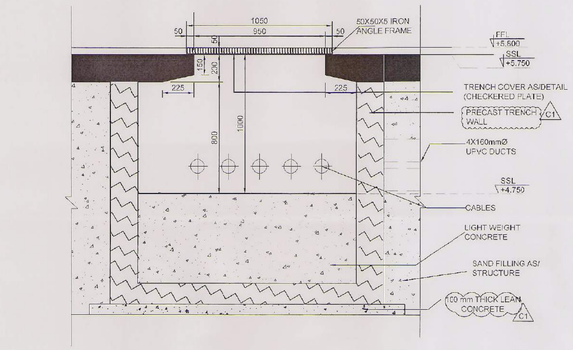
10 TYPICAL TRENCH DETAIL
SCALE 1:20



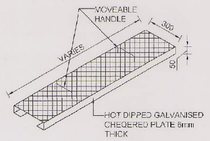
8 SECTION
SCALE 1:50



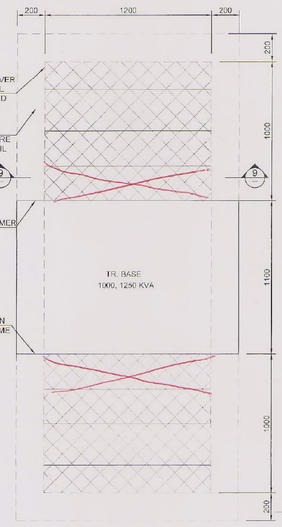
7 SECTION
SCALE 1:50



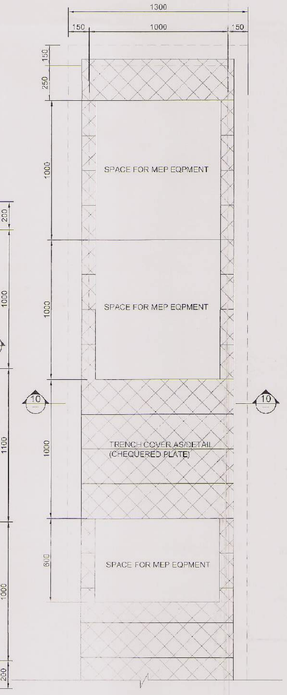
9 TYPICAL 11KV TRENCH DETAILS (TYP)
SCALE 1:20



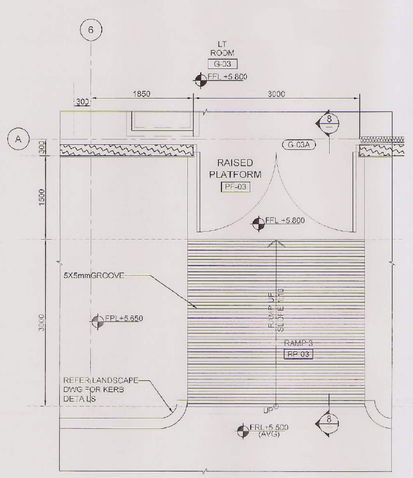
12 TYPICAL TRENCH COVER
SCALE 1:20



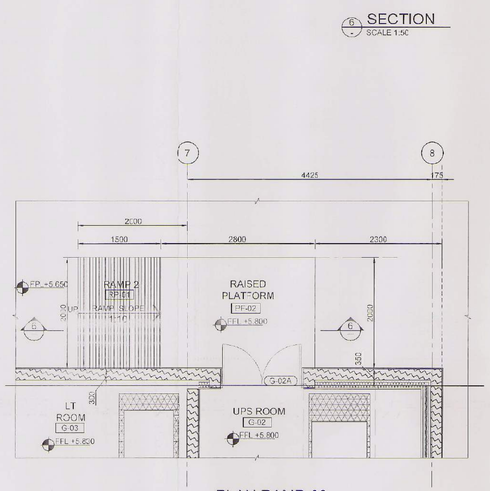
5 TYPICAL TRENCH PLAN-2
SCALE 1:20



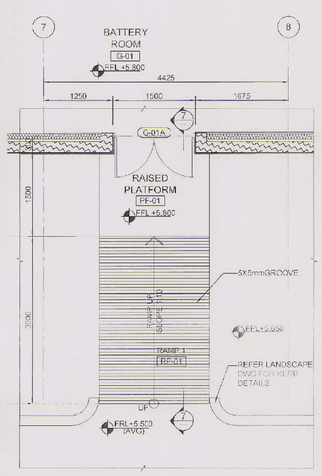
4 TYPICAL TRENCH PLAN-1
SCALE 1:20



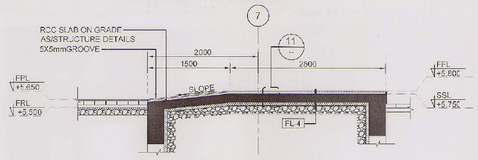
3 PLAN RAMP-03
SCALE 1:50



2 PLAN RAMP-02
SCALE 1:50



1 PLAN RAMP-01
SCALE 1:50



6 SECTION
SCALE 1:50

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. HT ROOM, TRANSFORMER ROOM AND LT ROOMS ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUE PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING, FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	200mm THK SOLID BLOCK WORK (4 HRS FIRE RATED)
	150mm THK HOLLOW CONCRETE BLOCK WORK
	PLASTER
	FILLING AS / STRUCTURE
	200mm THK SOLID CONCRETE BLOCK WORK
	SCREED
	RCC
	12mm T-HK INTERNAL GYPSOARD
	INSULATION INFILL AS/SPECIFICATION
	PRECAST WALL & ROOF

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	BCP	HSH

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
NORTH ISLAND
SUBSTATION (BSS-1)
MISCELLANEOUS DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED	02-07-17	02-07-17	02-07-17	02-07-17

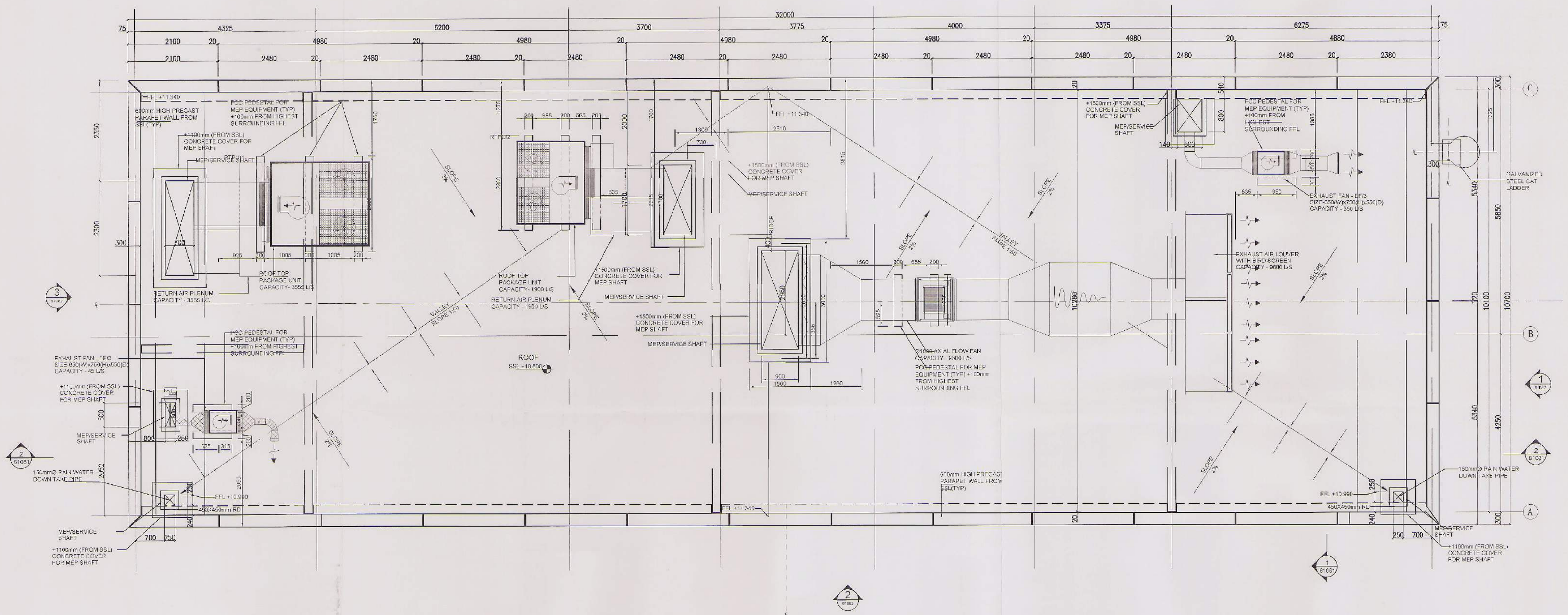
CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-63547

REV. C1

A1(594x841mm +/-2mm)



ROOF PLAN
SCALE 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	200mm THK SOLID CONCRETE BLOCK WORK
	SCREED
	RCC
	TRENCH COVER

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS/ MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH
CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN.& FACILITY BUILDING- ARCHITECTURE
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - ROOF PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-63548

REV. C1

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

BUILDING ARCHITECTURE – AUTHORITY SUBMITTALS
SUBSTATION BSS-1 (NORTH ISLAND) - DRAWINGS PACKAGE

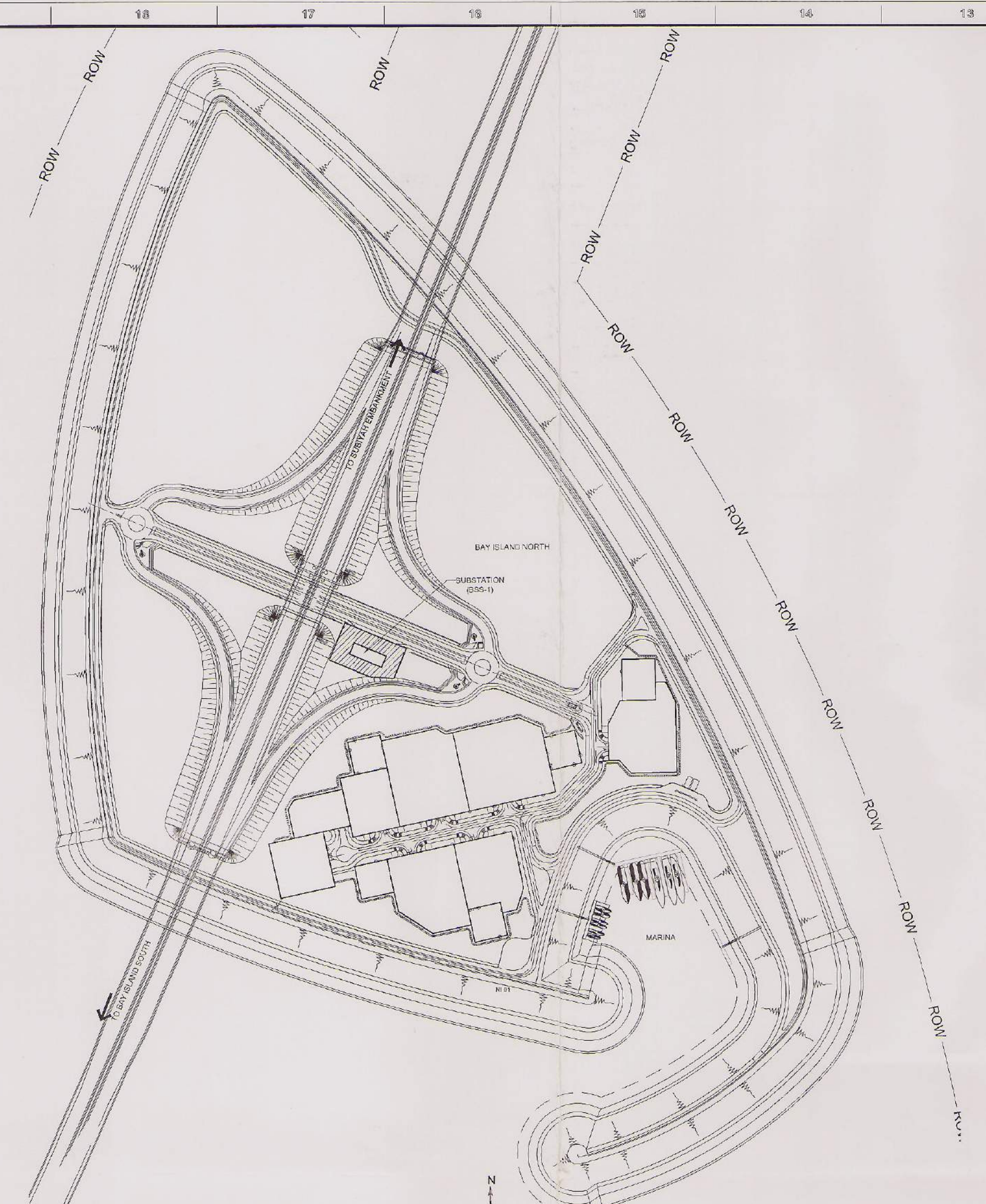
Drawing package No.: RA140-32-BUI-AR-DW-81095-C1

Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-AR-DW-81095	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	SITE LOCATION LAYOUT	
RA140-32-BUI-AR-DW-81096	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	ACCESS ROAD LAYOUT	
RA140-32-BUI-AR-DW-81097	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	ROAD LAYOUT – DIMENSION PLAN	
RA140-32-BUI-AR-DW-81098	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	AREA CALCULATION	
RA140-32-BUI-AR-DW-81099	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT – GROUND FLOOR PLAN	
RA140-32-BUI-AR-DW-81100	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT – ROOF PLAN	
RA140-32-BUI-AR-DW-81101	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT - SECTION	
RA140-32-BUI-AR-DW-81102	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT - ELEVATION	
RA140-32-BUI-AR-DW-81103	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	LIFE SAFETY PLAN	
RA140-32-BUI-AR-DW-81104	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	NORTH ISLAND	SUBSTATION (BSS-1)	GENERAL ARRANGEMENT – TRAFFIC MARKING	

Project Information بيانات المشروع			
Sheikh Jaber Al-Ahmed Al-Sabah Causeway (Main Link)	جسر الشيخ جابر الأحمد الصباح (الجسر الرئيسي)	Project Name	اسم المشروع
Ministry of Public Works	وزارة الأشغال العامة	Client Name	اسم المالك
Systra	سيسترا	International Consultant	المكتب الاستشاري العالمي
The Hyundai- CGC Consortium	تحالف شركة هيونداي – شركة المجموعة المشتركة للمقاولات	The Main Contractor	المقاول/ المتعهد الرئيسي
Pace	المكتب العربي للاستشارات الهندسية	Local Consultant	المكتب الاستشاري المحلي
BSS-1 Building		Building Name	اسم المبنى
North Island		The Address	العنوان
		Survey Plan No.	رقم المخطط المساحي
	$2107m^2$	Plot Area	مساحة القسيمة
	$342.40m^2$ 16.35 %	Total Building area/Building Ratio	مساحة ونسبة البناء
	G	Floor No.	عدد الطوابق
	7.700m	Building Height	الارتفاع
New permit	بناء جديد	Proposed permit Such as (New building permit or revised permit)	المطلوب ترخيصه (بناء جديد/ تحويل)

Building's areas schedule جدول مساحات المبنى

ملاحظات Comments	Total Area	مساحة الخدمات Services Areas	المساحة المستغلة Used Areas	الطابق Floor	م Sr.
BSS-1 Building	342.40	0.124	342.276	الطابق الأرضي /المستوى ± 0م Ground Floor/ FFL +5.800m	1
	342.40.		342.276	إجمالي المساحة Total Areas	2

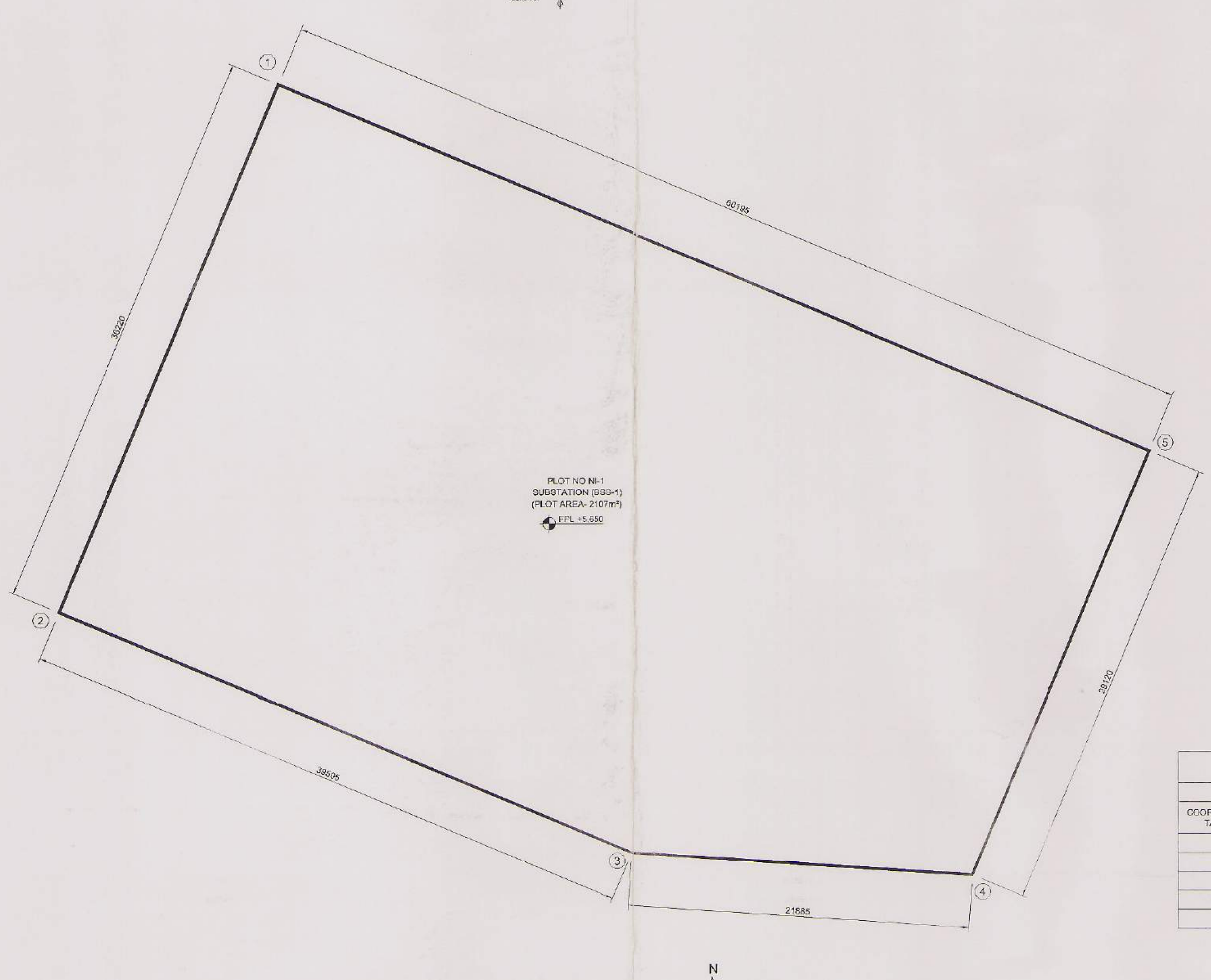


KEY PLAN @ BAY ISLAND NORTH

SCALE - 1:2500

KEY PLAN @ KUWAIT CITY & SUBURBS

SCALE - NTS



SITE COORDINATES

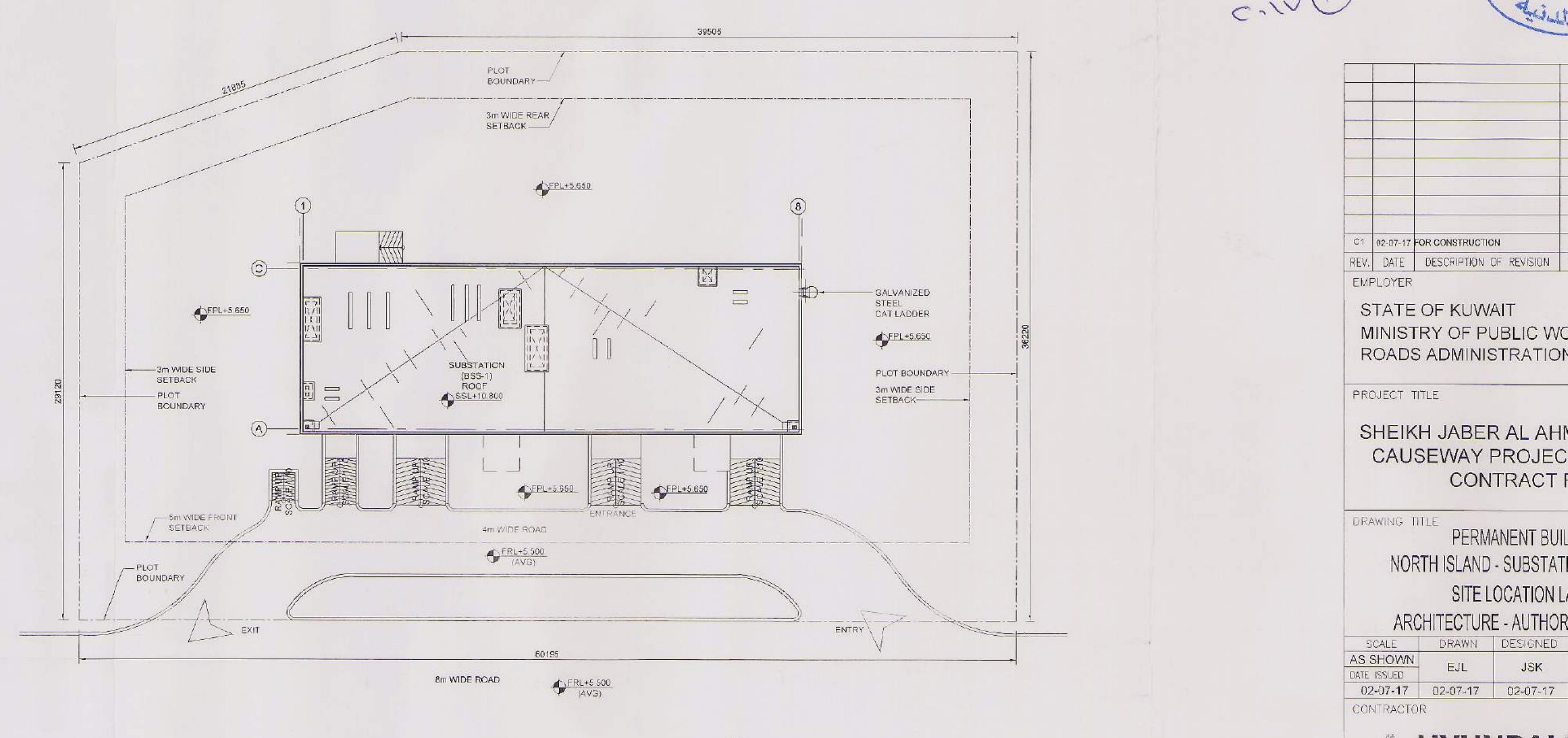
SUBSTATIONS BSS-1

PLOT NO. NI-1

COORDINATE TAGS	NORTHING	EASTING
1	3265281.418	501545.578
2	3265247.997	501531.622
3	3265232.750	501568.065
4	3265231.347	501589.903
5	3265258.216	501601.123

LEVEL PLAN @ SUBSTATION (BSS-1)

SCALE - 1:200



SITE PLAN @ SUBSTATION (BSS-1)

SCALE - 1:200

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH
CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
SITE LOCATION LAYOUT
ARCHITECTURE - AUTHORITY SUBMITTAL

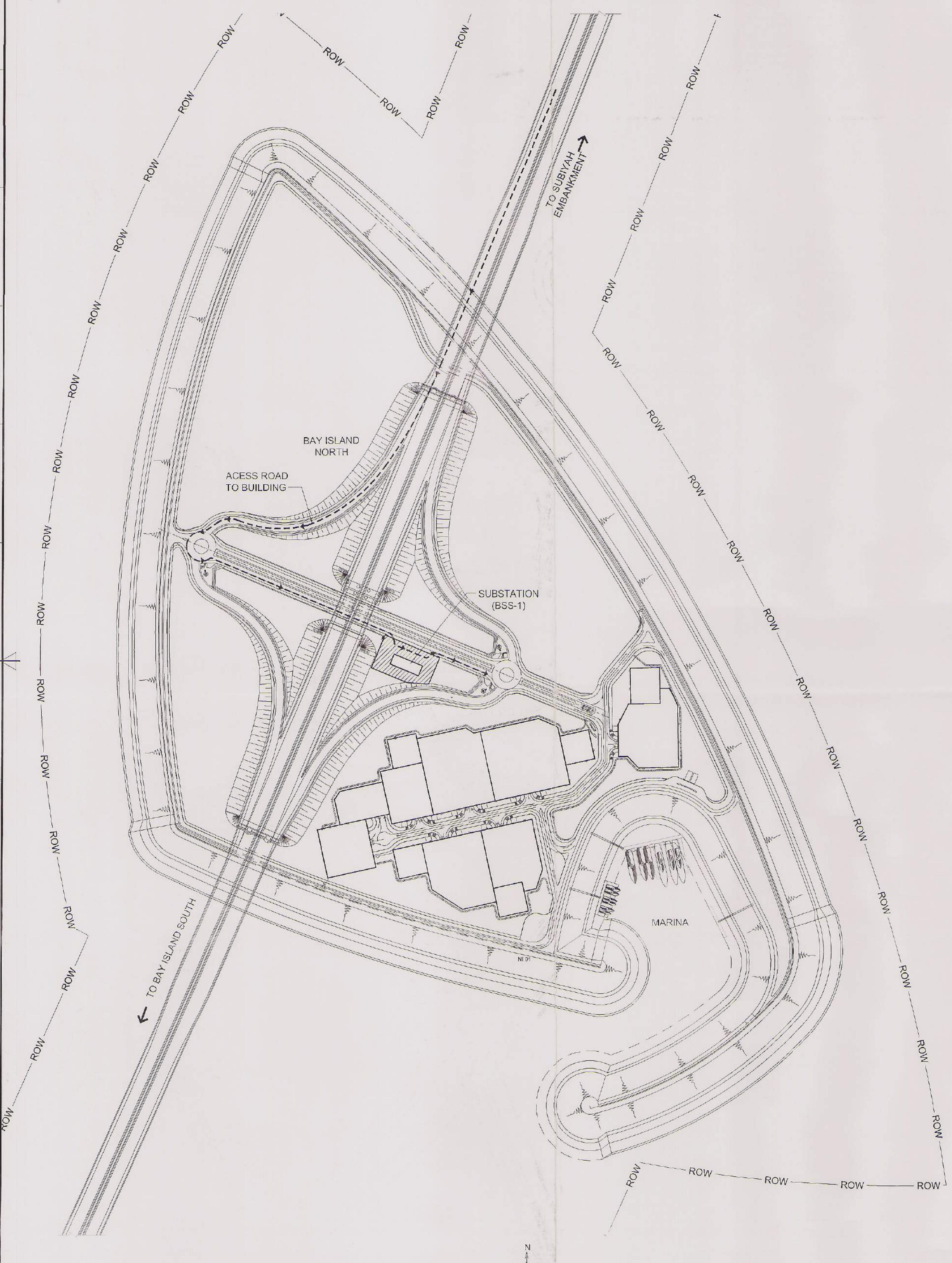
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

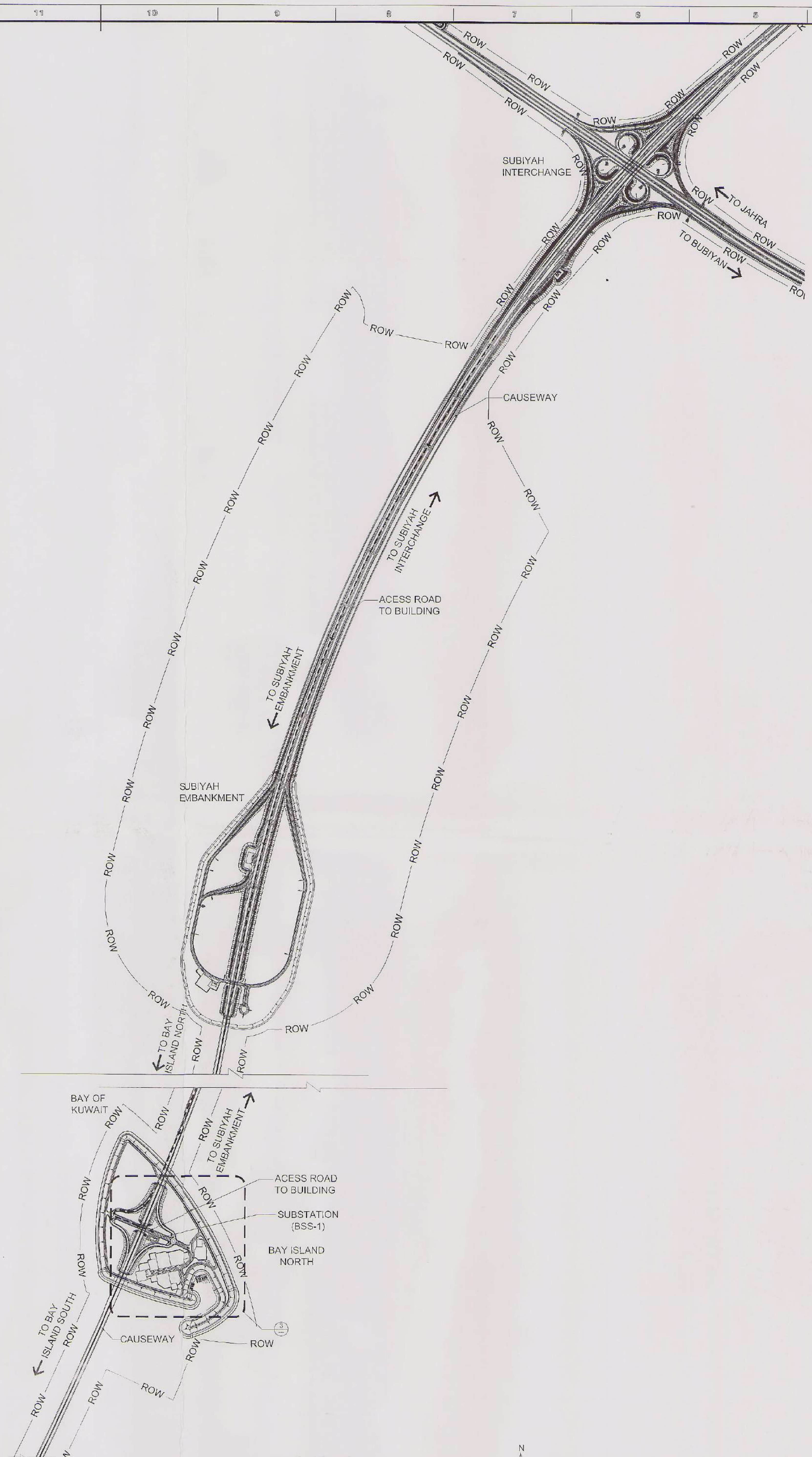
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81095

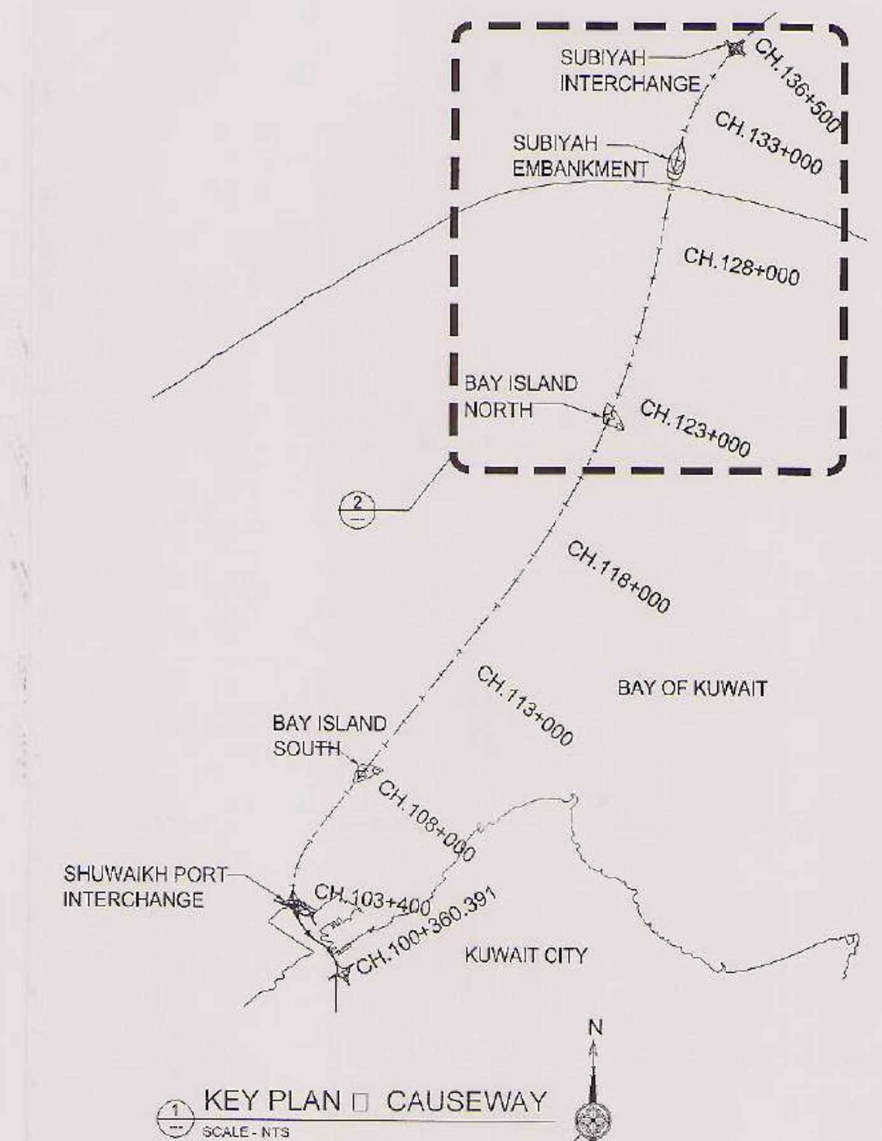
REV. C1



KEY PLAN - BAY ISLAND NORTH
SCALE - 1:2000



KEY PLAN - BAY ISLAND NORTH, SUBIYAH EMBANKMENT - SUBIYAH INTERCHANGE
SCALE - 1:10000



KEY PLAN - CAUSEWAY
SCALE - NTS

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
ACCESS ROAD LAYOUT
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

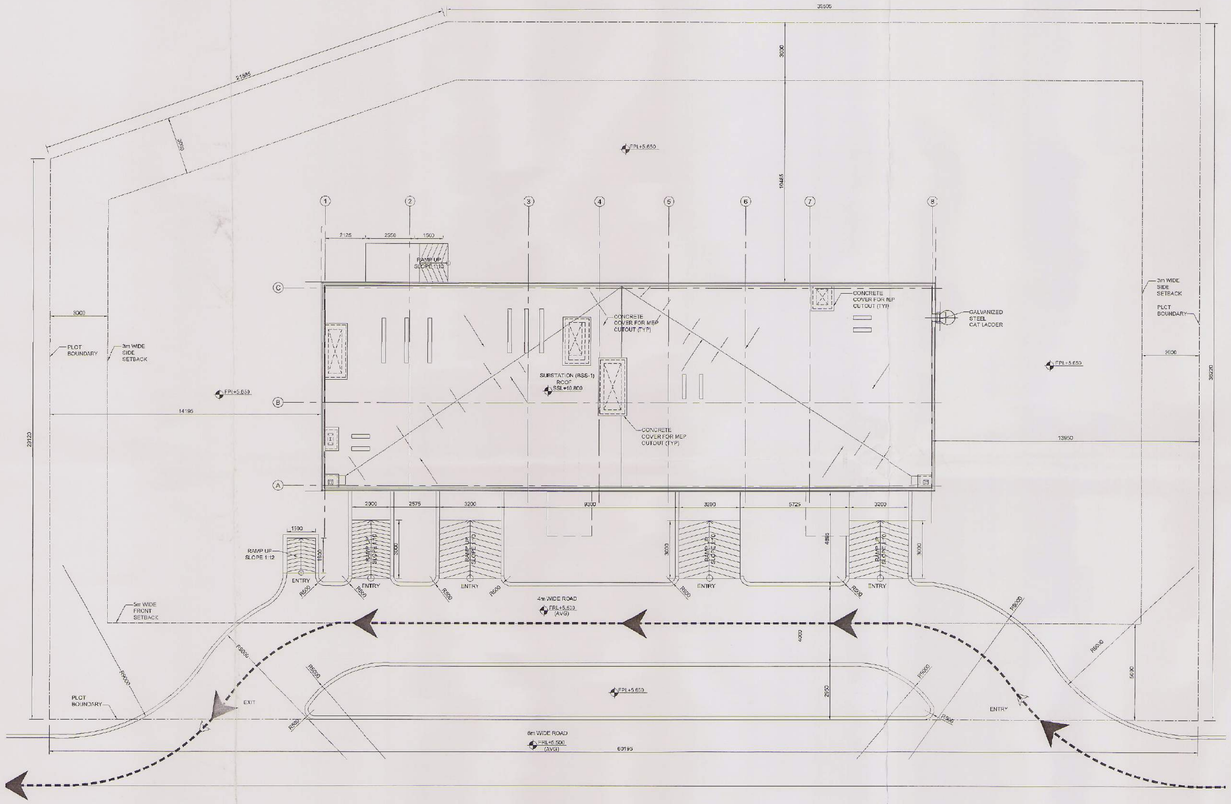
DRAWING NO.	REV.
RA140-32-BUI-AR-DW-81096	C1

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m INCH-FIX FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS ! ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING, FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

LEGEND:

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
FGL	FINISHED GROUND LEVEL
	LEVEL
	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER DETAIL DWGS
	PLOT BOUNDARY
	FIRE TENDER ROUTE & DIRECTION
	INGRESS/EGRESS ENTRY/EXIT
ROW	RIGHT OF WAY
	EMBANKMENT



1 ROAD LAYOUT (DIMENSIONS PLAN) ⊓ SUBSTATION (BSS-1)
SCALE - 1:100

REV	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC	APPRD
C1	02-07-17	FOR CONSTRUCTION	EA	HSH	BCP

EMPLOYER:

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE:

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE:

PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
ROAD LAYOUT - DIMENSION PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

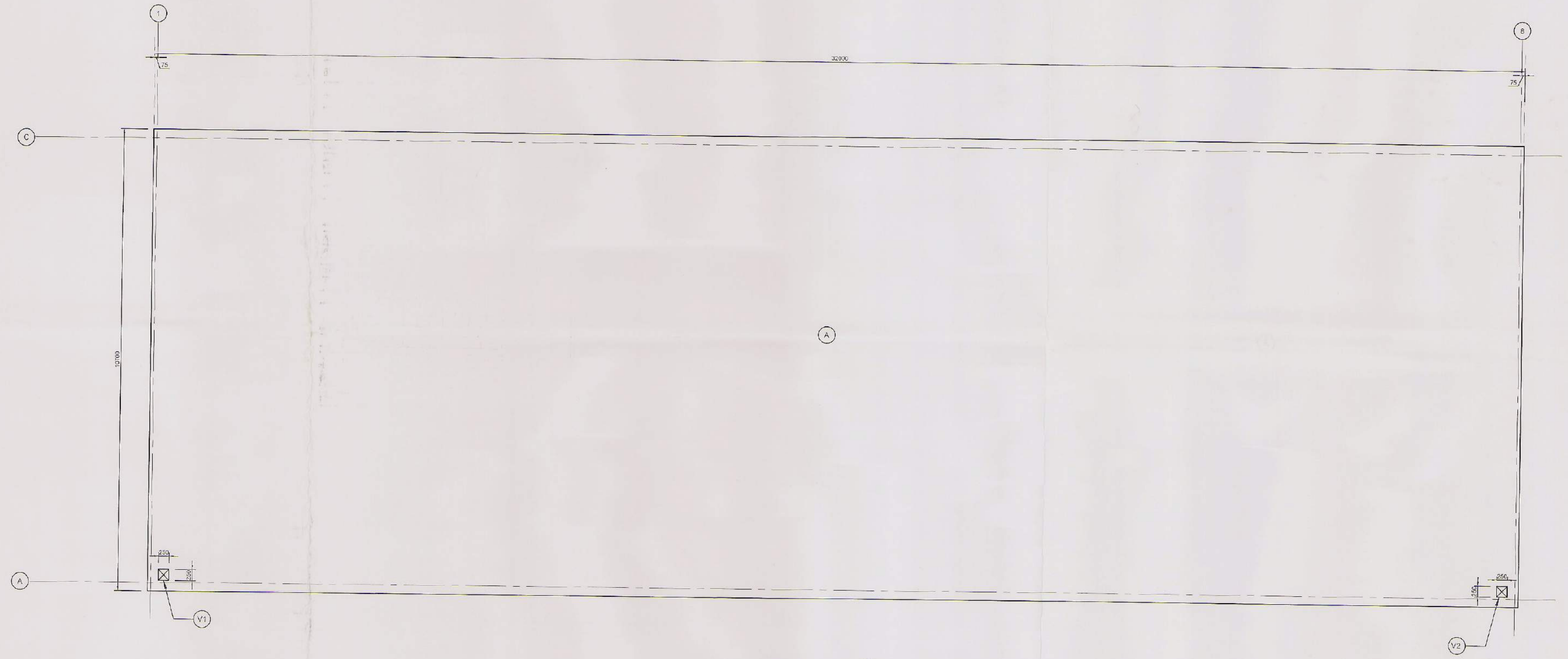
CONTRACTOR:

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.: RA140-32-BUI-AR-DW-81097

REV.: C1

وزارة الكهرباء والماء
شبكات التوزيع الكهربائية
قطاع الأعمال المدنية



GROUND FLOOR AREA
SCALE 1:50

AREA CALCULATION CHART - GROUND FLOOR

COVERED AREA				
NAME TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM	
A	32000	10700	Length x Width	342.40
(a) TOTAL COVERED AREA				342.40

AREA OF VOIDS (Less than $1m^2$)				
NAME TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM	
V1	250	250	Length x Width	0.062
V2	250	250	Length x Width	0.062
(b) AREA OF VOIDS (Less than $1m^2$)				0.124

AREA OF VOIDS (More than or equal to $1m^2$)				
NAME TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM	
-	-	-	-	-
(c) AREA OF VOIDS (More than or equal to $1m^2$)				-

TOTAL AREA OF VOIDS (b+c) = 0.124 + 0.00 =	0.124
TOTAL AREA = a - (b+c)= 342.40 - 0.124 =	342.276

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
AREA CALCULATION
ARCHITECTURE - AUTHORITY SUBMITTAL

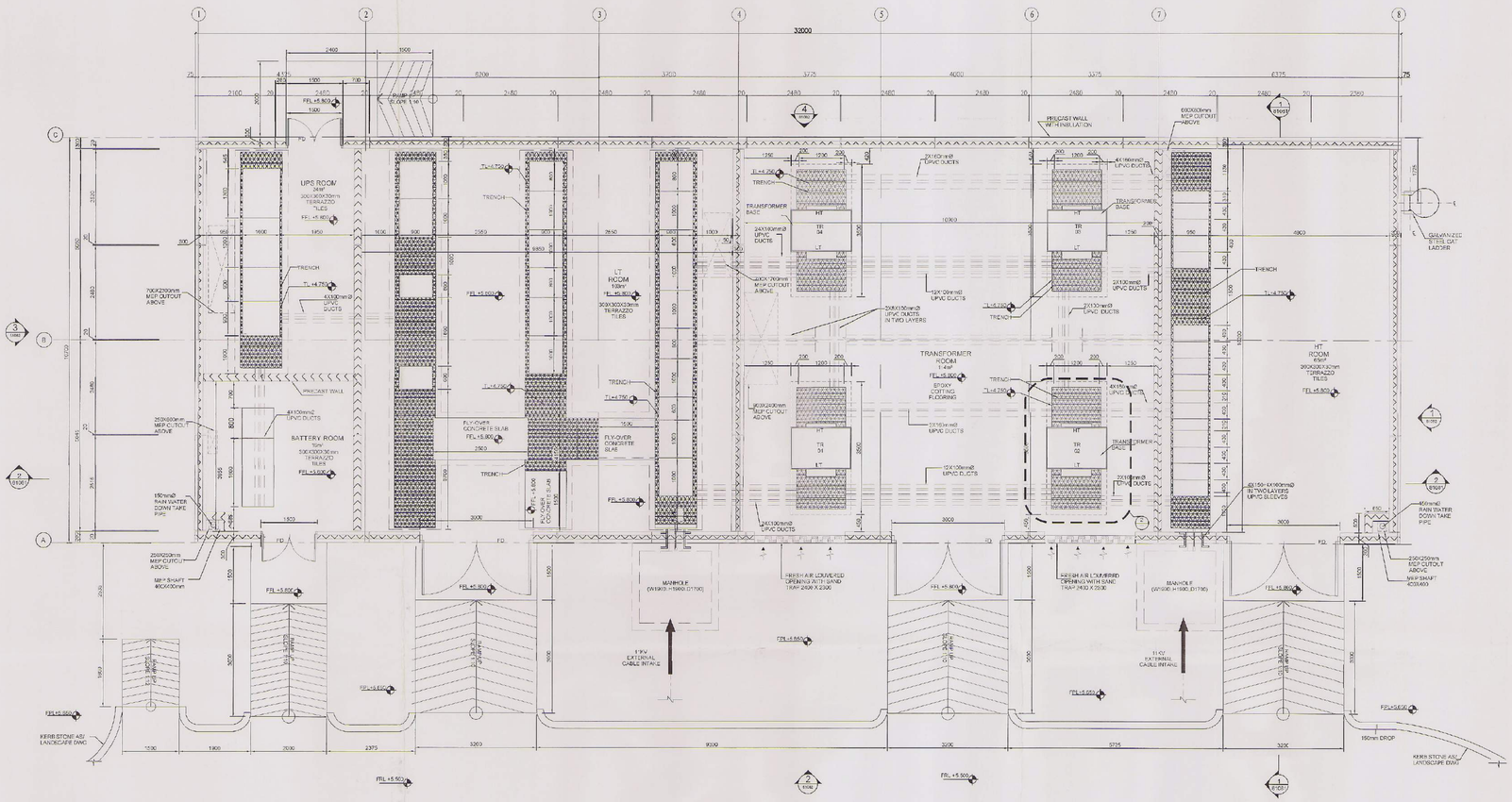
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

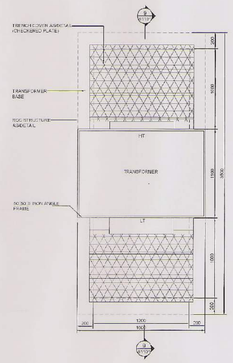
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81098

REV. C1



1 GROUND FLOOR PLAN
SCALE 1:50



3 TRANSFORMER BASE
SCALE 1:25

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FBL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	SCREED
	RCC
FFL FFL	FRESH A.I.R LOUVERED OPENING WITH SAND TRAP 3400X2300
	TRENCH COVER
	PRECAST WALL / ROOF

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION S-HALL BE PROVIDED WITH ALTERNATE TO HYLON PROTECTION SUBJECT TO M.E.W APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHEQUERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUERED PLATE SHALL NOT BE MORE THAN 250MM WIDE SUBJECT TO M.E.W APPROVAL/ STANDARD THICKNESS OF THE PLATE SHALL BE 6mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS S-OULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS S-OWN S-HALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALOW INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE AS PER NFD REQUIREMENT.
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND LT ROOMS/ HT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES, ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVE/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE 11 CABLE FROM TRANSFORMER TO HT. PB SHALL NOT EXCEED 10 METRS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS M.E.P REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - GROUND FLOOR PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

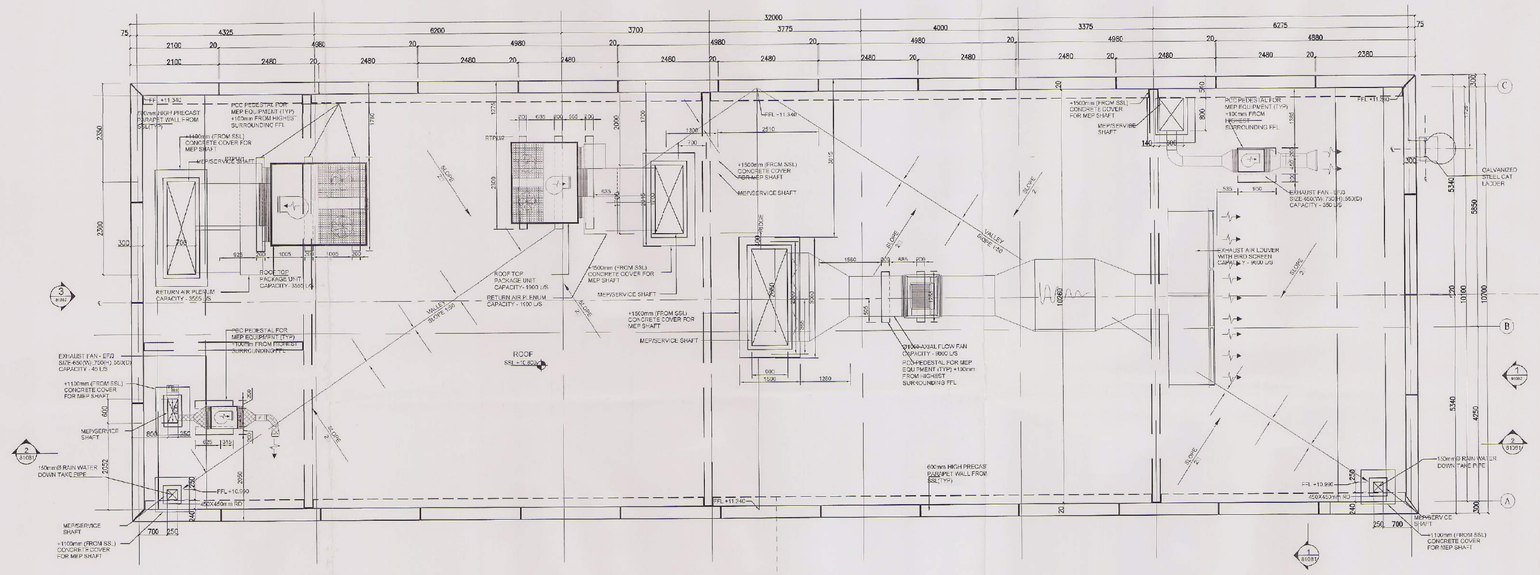
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUE				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO
RA140-32-BUI-AR-DW-81099

REV.
C1

وزارة الكهرباء والماء
إدارة شئون التوزيع الكهربائية
قسم الأعمال المدنية



ROOF PLAN
SCALE 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	200mm THK SOLID CONCRETE BLOCK WORK
	SCREED
	RCC
	TRENCH COVER

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2 HOURS AS PER KFD REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING WAVE AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.D. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO RAIN PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. END USER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR ACCESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND ACCESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT).
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING BUT OF ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 30 METERS.
18. IT IS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR DECC.
20. ALL DOORS ARE STEEL DOORS AS MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

وزارة الكهرباء والماء
الإدارة المركزية لشبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	30-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

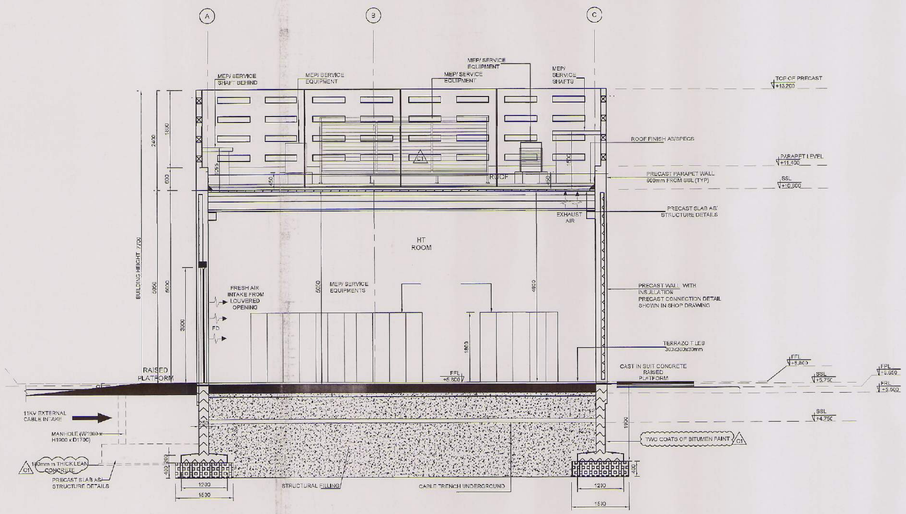
PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - ROOF PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

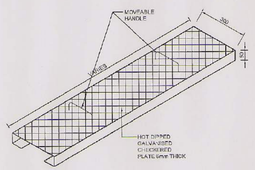
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

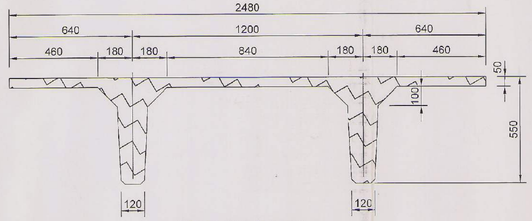
DRAWING NO. RA140-32-BUI-AR-DW-81100
REV. C1



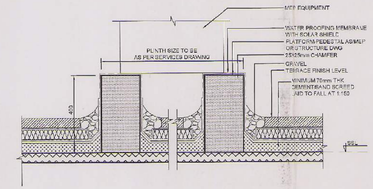
SECTION
SCALE: 1:100



TYPICAL TRENCH COVER DETAIL
SCALE: NTS



TYPICAL DT SLAB DETAIL
SCALE: NTS



TYP PLINTH DETAIL @ TERRACE LEVEL FOR SERVICE EQUIPMENTS
SCALE 1:50 (NOTE: REF TO MEP DRAWING PACKAGE FOR MEP EQUIPMENT VIBRATION DAMPER DETAIL)

SYMBOL LEGEND

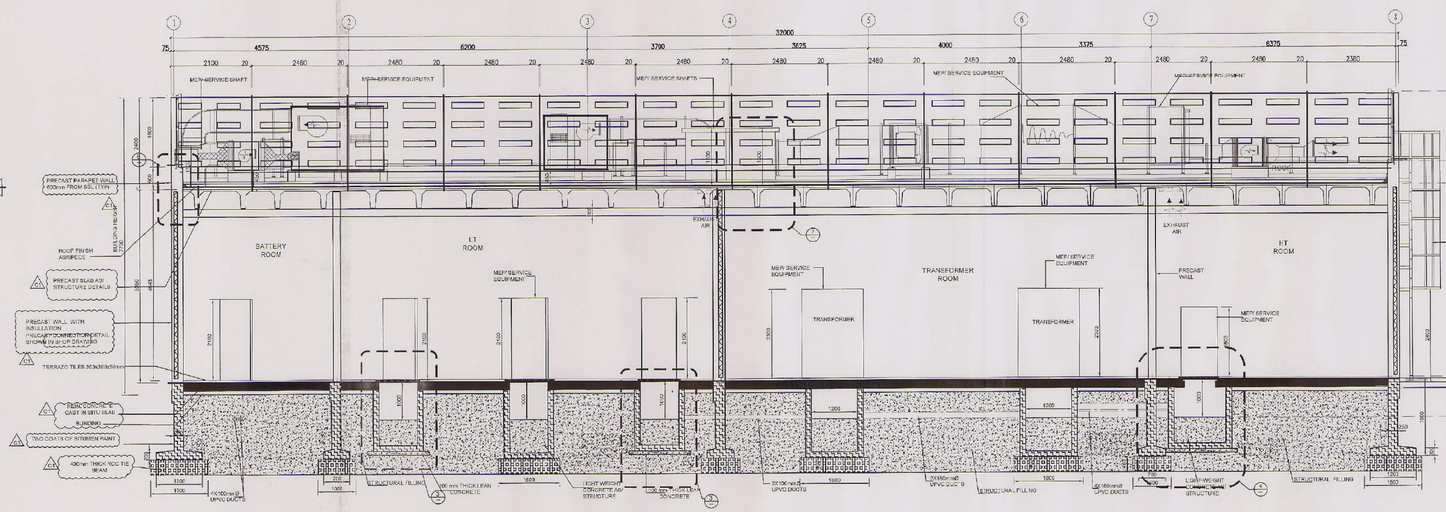
SYMBOL	DESCRIPTION
FFL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
L	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	FILLING AS/ STRUCTURE
	SCREED
	RCC
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION
	TRENCH COVER
	BLOCK WORK
	RCC TIE BEAM
	LEAN CONCRETE

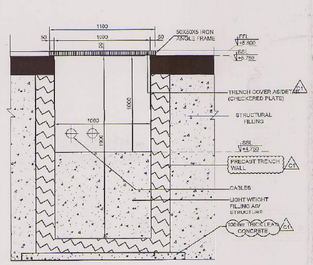
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM SHALL BE FIRE RATED FOR 2HOURS AS PER K.N.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUBSTATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MINIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 230mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT S OF DRAWING.
9. AS PART OF THE CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUBSTATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPEN NOR SHOULD BE KEPT IN THE TRENCH COVER FOR INSPECTION OF CABLE. ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL JOINTS BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. COORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO EMPLOY NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO METER SHALL NOT EXCEED 20 METERS.
18. IT IS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS ARE ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND COUNT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BOXE.
20. ALL DOORS ARE STEEL DOORS AS PER REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

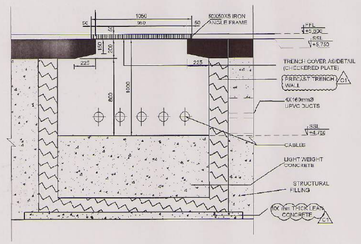


SECTION
SCALE: 1:50

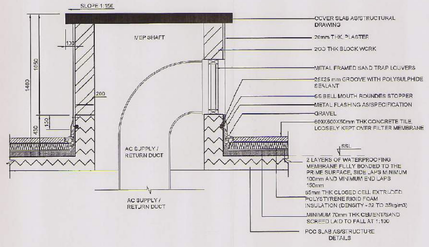
TYPICAL PARAPET DETAIL
SCALE 1:10



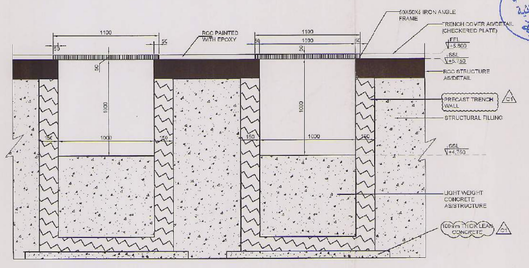
TYPICAL TRENCH DETAIL
SCALE 1:20



HT ROOM TRENCH DETAILS
SCALE 1:20



SLAB CUTOUT ENCLOSURE DETAIL
SCALE 1:20



TRANSFORMER ROOM TRENCH DETAILS
SCALE 1:20

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	R.B.	HSH	RCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - SECTIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

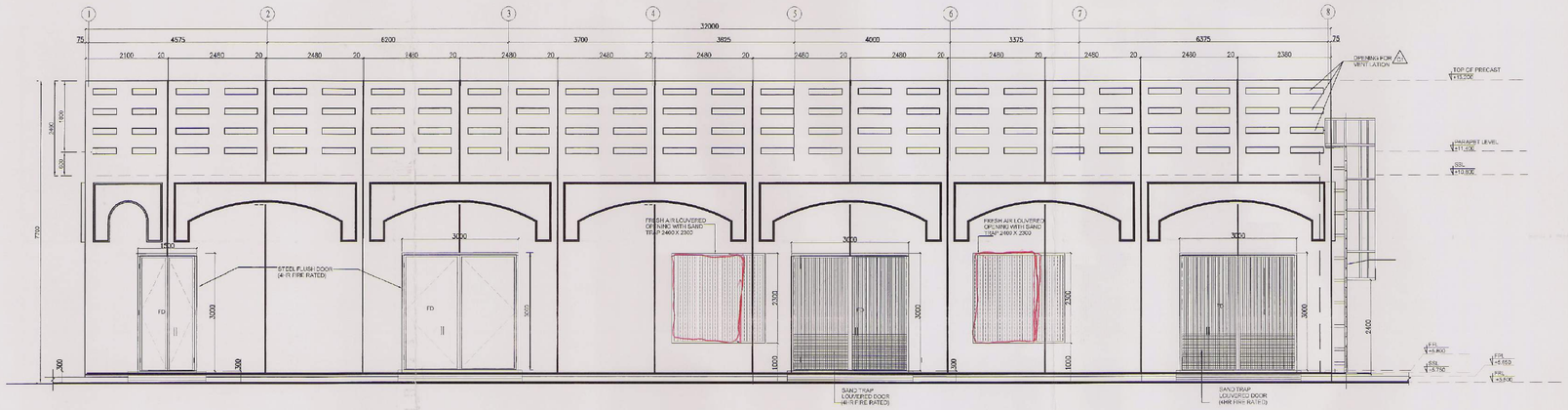
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	B.R.	JSK	HSH	RCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

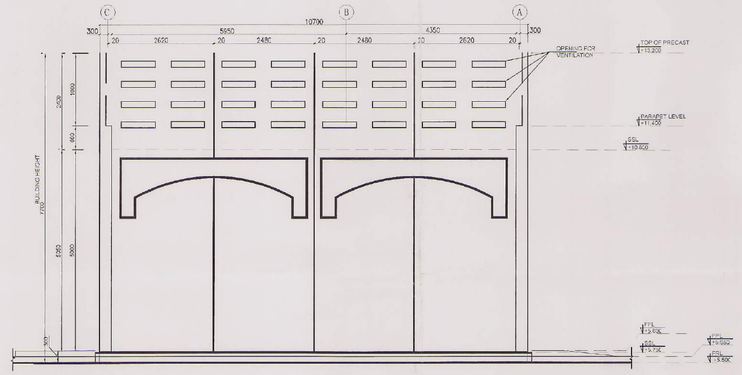
DRAWING NO.
RA140-32-BUI-AR-DW-81101

REV.
C1

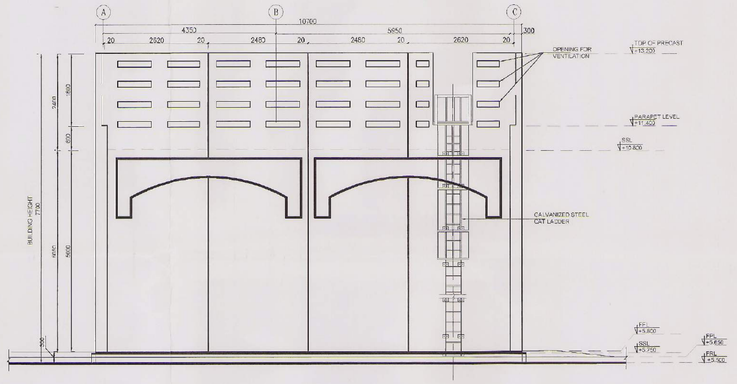
وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية



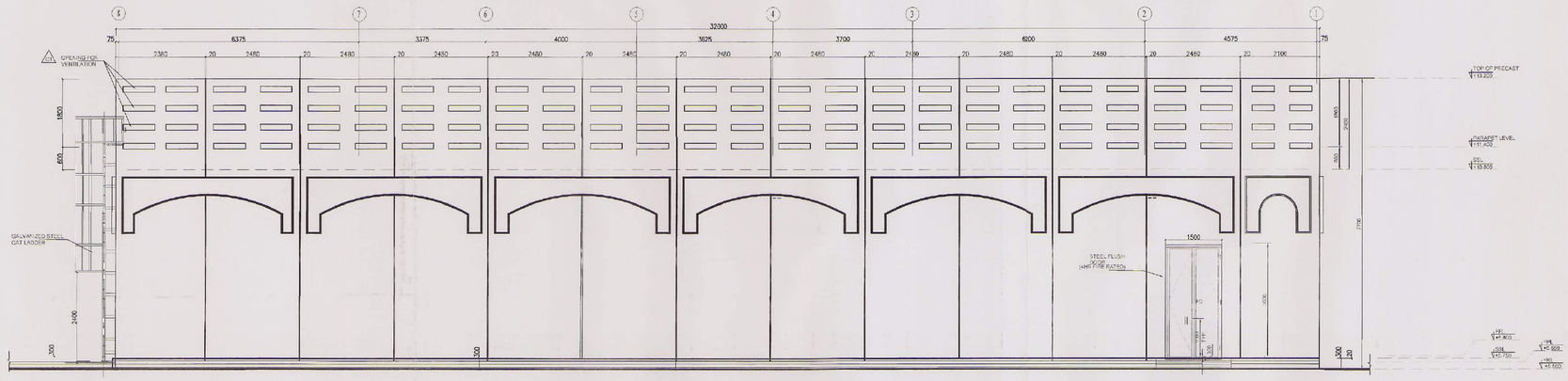
ELEVATION
SCALE - 1:50



ELEVATION
SCALE - 1:50



ELEVATION
SCALE - 1:50



ELEVATION
SCALE - 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOMS ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUBSTATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO M.E.W APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 8mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER K.F.D REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. COORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR SEALING & PREVENTURES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTORS RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH FINISHES HAS BEEN ASSUMED.
19. ALL INTERIOR R.R DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS PER REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.
22. ALL WALLS ARE INSULATED.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHKD.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	ECP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

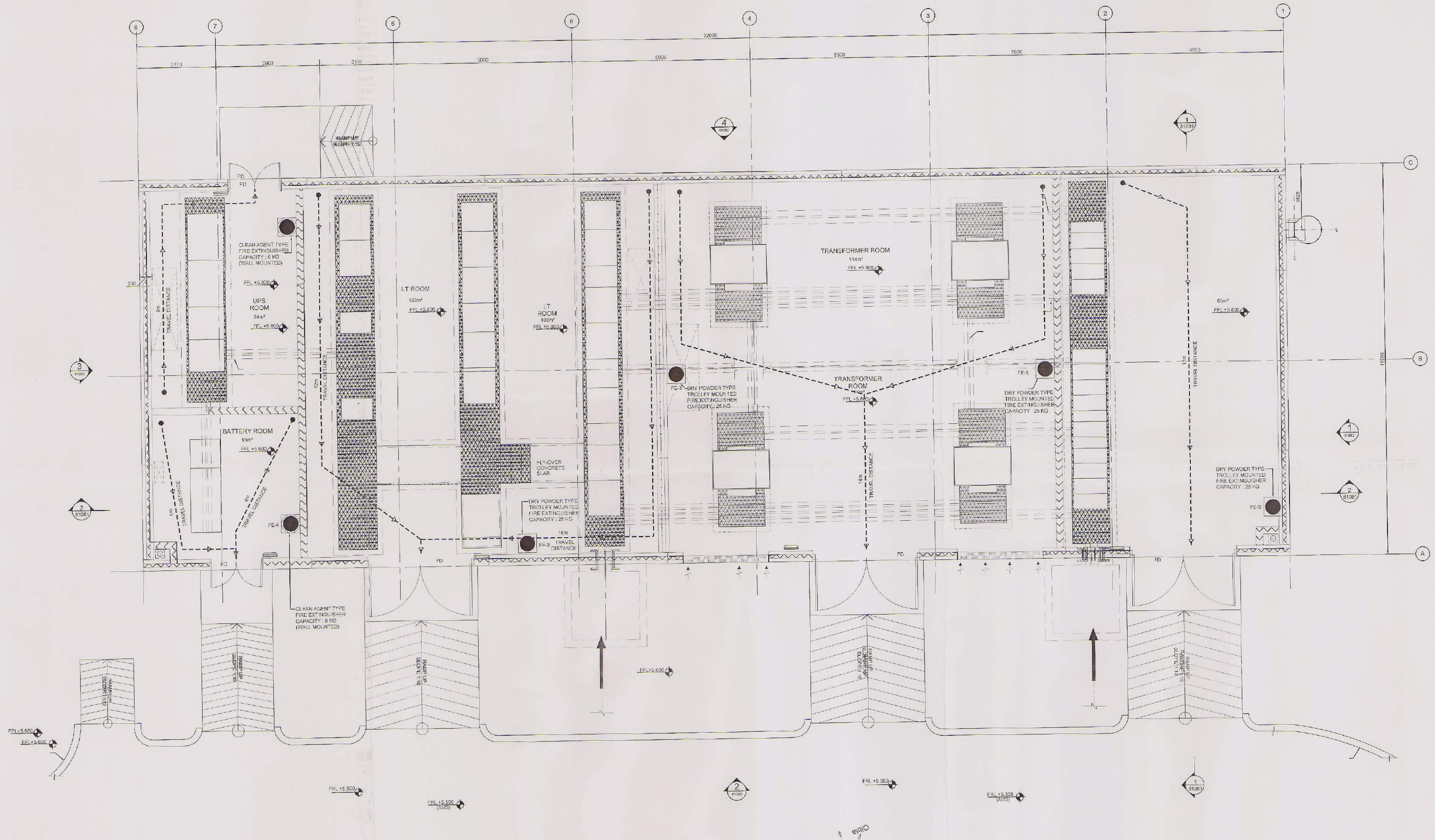
DRAWING TITLE
PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - ELEVATIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	ECP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-81102

REV.
C1



GROUND FLOOR PLAN
SCALE - 1:50

SHEETS NOTES

1. ALL TRAVEL DISTANCES ARE MEASURED FROM THE DOOR OF ANY ROOM TO THE FINAL POINT OF EXIT.
2. ALL TRAVEL DISTANCES SHALL BE LESS THAN OR EQUAL TO 30M.
3. THE MAXIMUM TRAVEL DISTANCE FROM THE FARTHEST POINT INSIDE THE ROOM TILL ITS EXIT DOOR SHALL NOT BE MORE THAN 15M.
4. THE MAXIMUM DEAD END DISTANCE SHALL NOT BE MORE THAN 7.5M

LEGEND

	1 HOUR FIRE RATED HOLLOW CONCRETE BLOCK WORK
	2 HOURS FIRE RATED HOLLOW CONCRETE BLOCK WORK
	4 HOURS FIRE RATED BLOCK WORK
	EGRESS ROUTE / TRAVEL DISTANCE
	START POINT
FD	FIRE DOOR
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
FGL	FINISHED GROUND LEVEL
	LEVEL
℄	CENTER LINE
	ENERGENCY EXIT LIGHT
	FIRE EXTINGUISHER

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR- CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
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14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS/ MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
LIFE SAFETY - PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

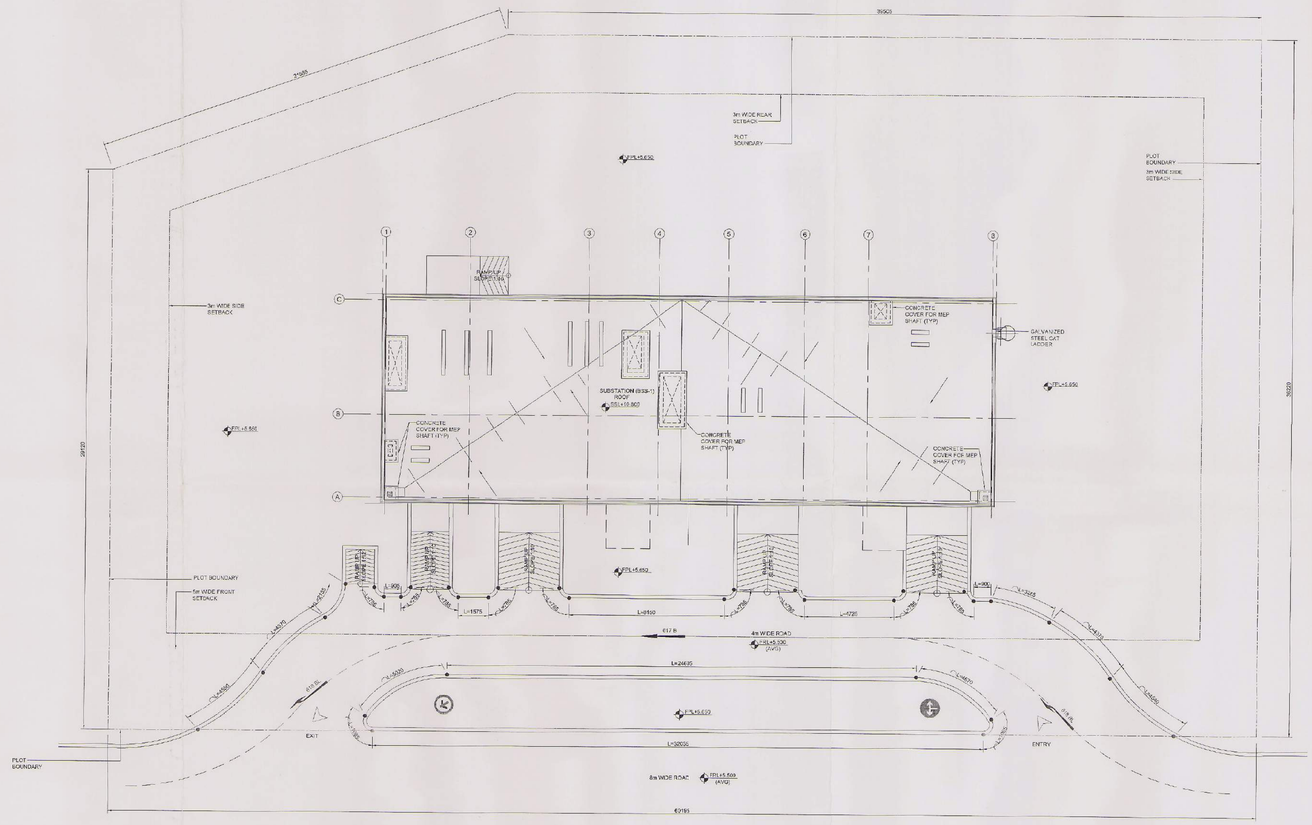
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED: 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81103

REV. C1



1 TRAFFIC MARKINGS & SUBSTATION BSS-1
SCALE - 1:100

TYPICAL SIGNAGE LEGEND

	617 B ROAD SIGN
	619 BL ROAD SIGN
SIGN 436R	TURNING RESTRICTED
SIGN 411	TURNING RESTRICTED
SIGN 411	ROAD SIGN

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROPOSE BUILDINGS IS TBC# AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROPOSE BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING, FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD / EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

LEGEND:

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
FGL	FINISHED GROUND LEVEL
	LEVEL
	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER DETAIL DWGS
	PLOT BOUNDARY
	FIRE TENDER ROUTE / DIRECTION
	INGRESS/ EGRESS/ ENTRY/ EXIT
ROW	RIGHT OF WAY
	EMBANKMENT

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC	APPRO.
C1	02.07.17	FOR CONSTRUCTION	EJI	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
NORTH ISLAND - SUBSTATION 11kv (BSS-1)
GENERAL ARRANGEMENT - TRAFFIC MARKINGS
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJI	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-81104

REV.
C1

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

ADMINISTRATION & FACILITY BUILDINGS - STRUCTURE
SUBSTATION BSS-1 (NORTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-CW-DW-65670-C1

Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-CW-DW-65671	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ELECTRICAL PLAN FOOTING & TRENCHES	
RA140-32-BUI-CW-DW-65672-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65672-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65672-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65672-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65672-5	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65672-6	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65673	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	RCC TIE BEAM DETAILS	
RA140-32-BUI-CW-DW-65674	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ERECTION PLAN DT & SECTION A-A	
RA140-32-BUI-CW-DW-65675-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ELEVATION	
RA140-32-BUI-CW-DW-65675-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ELEVATION	
RA140-32-BUI-CW-DW-65676-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-5	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-6	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

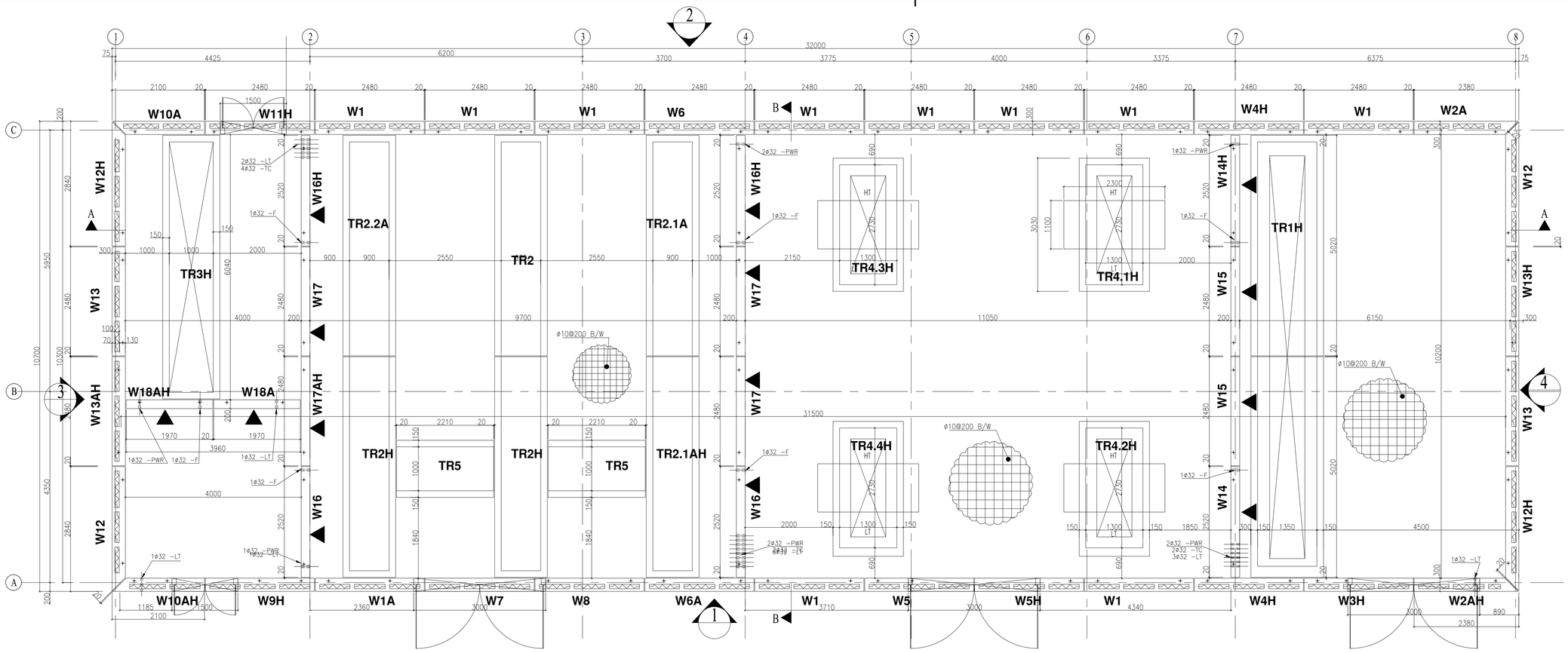
ADMINISTRATION & FACILITY BUILDINGS - STRUCTURE
SUBSTATION BSS-1 (NORTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-CW-DW-65670-C1

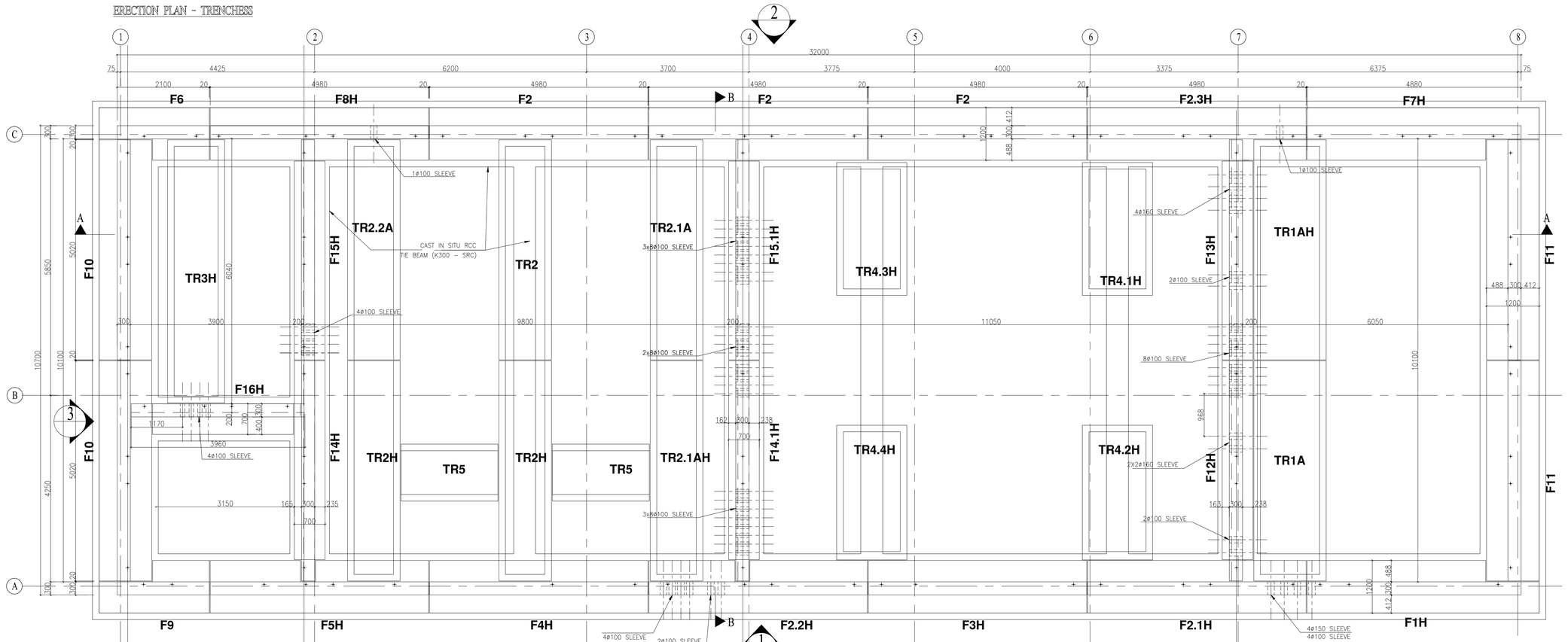
Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-CW-DW-65676-7	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-8	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-9	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-10	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-11	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-12	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-13	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65676-14	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65677	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	STRUCTURAL TOPPING CONCRETE	
RA140-32-BUI-CW-DW-65678-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	DT UNIT DETAIL	
RA140-32-BUI-CW-DW-65678-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	DT UNIT DETAIL	
RA140-32-BUI-CW-DW-65679-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65679-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65679-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65679-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65680	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ERECTION PLAN FOOTING & TRENCHES	
RA140-32-BUI-CW-DW-65681	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TYPICAL WALL DETAILS	

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



ERECTION PLAN - TRENCHESS



ERECTION PLAN - FOOTINGS & TRENCHES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ERECTION PLAN FOOTING & TRENCHES

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

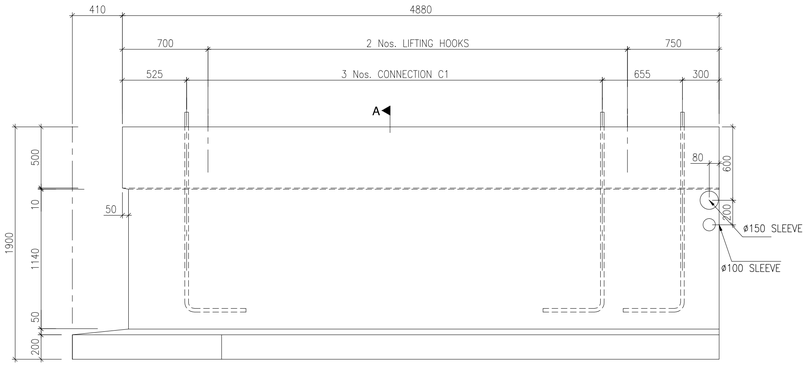
DRAWING NO.

RA140-32-BUI-CW-DW-65571

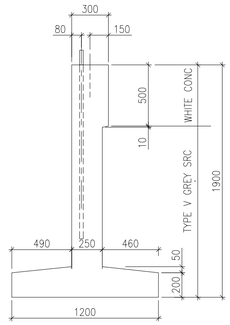
REV.

C1

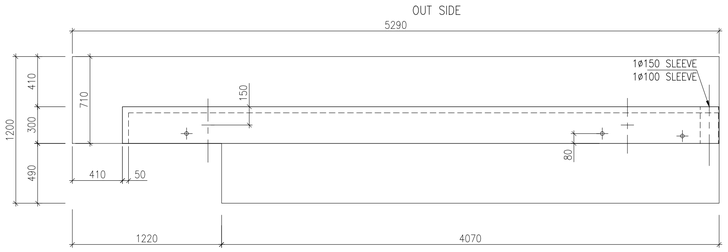
A0(841X1197mm +2mm)



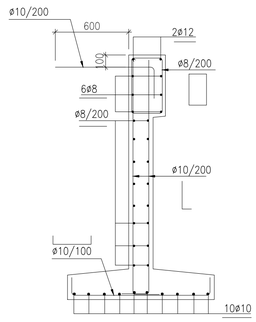
ELEVATION



SECTION-A



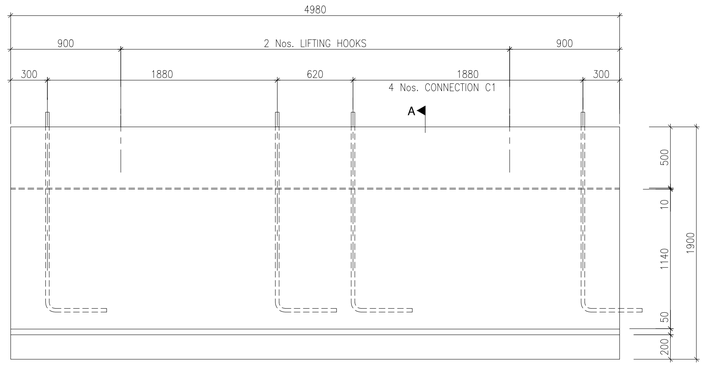
PLAN



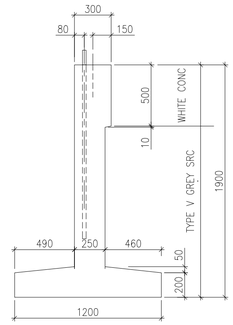
SECTION-A
SHOWING REINF.

FOOTING - F1H

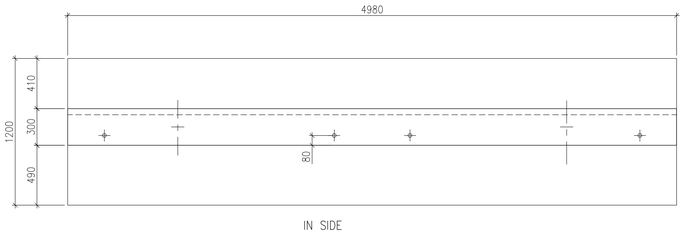
Nos. REQD. = 1 VOLUME 3.69 m³



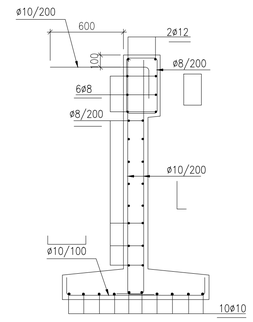
ELEVATION



SECTION-A



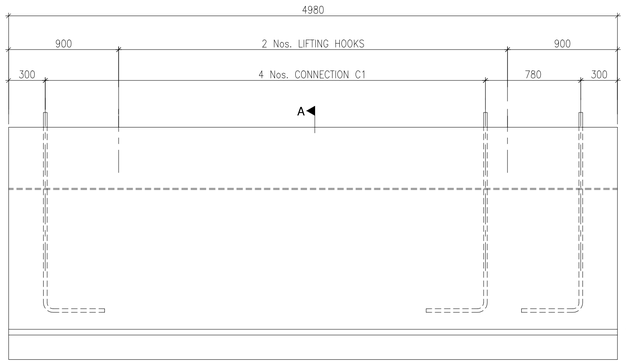
PLAN



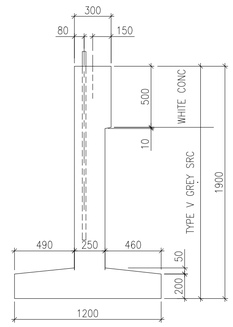
SECTION-A
SHOWING REINF.

FOOTING - F2

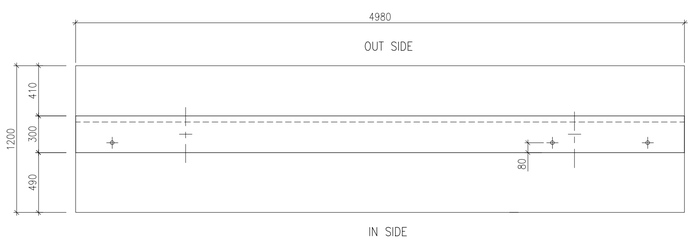
Nos. REQD. = 3 VOLUME 3.68 m³



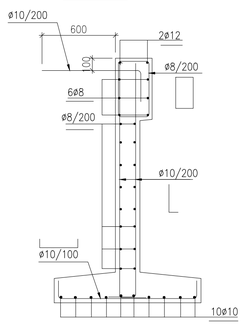
ELEVATION



SECTION-A



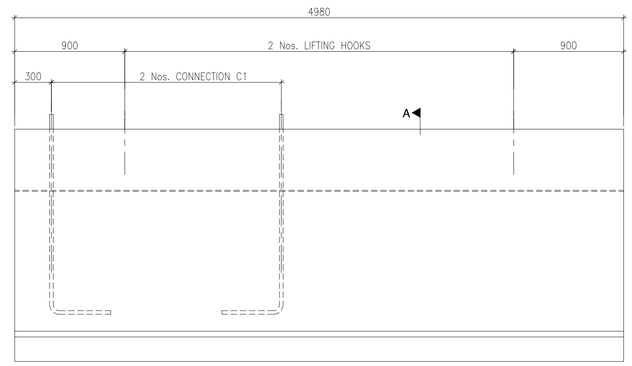
PLAN



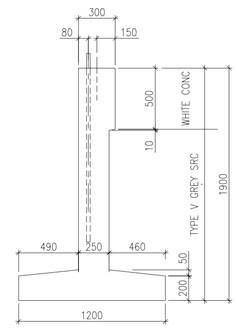
SECTION-A
SHOWING REINF.

FOOTING - F3H

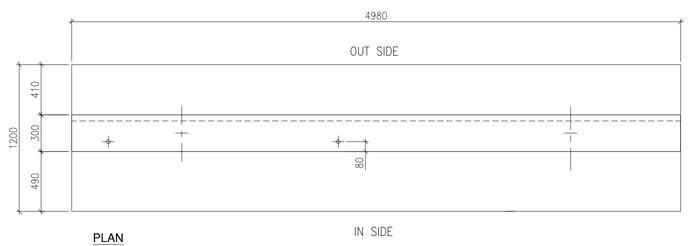
Nos. REQD. = 1 VOLUME 3.68 m³



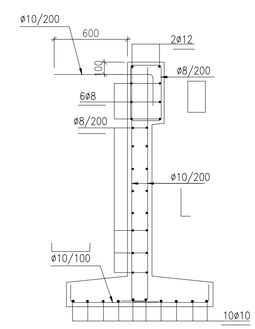
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F4H

Nos. REQD. = 1 VOLUME 3.68 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

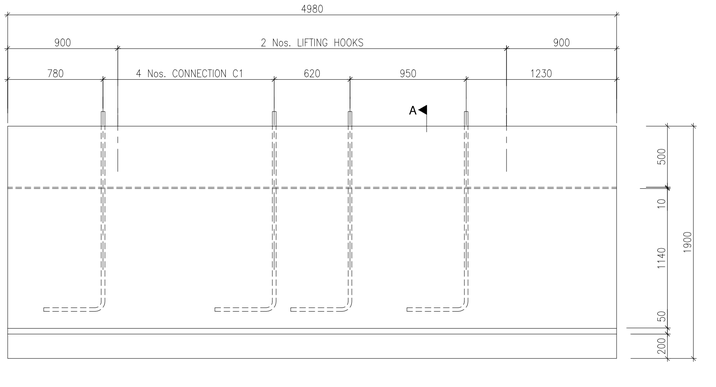
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

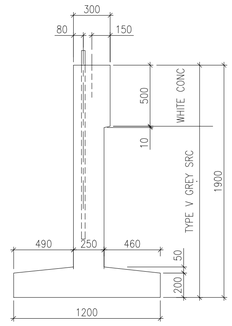
DRAWING NO. RA140-32-BUI-CW-DW-65672-1

REV. C1

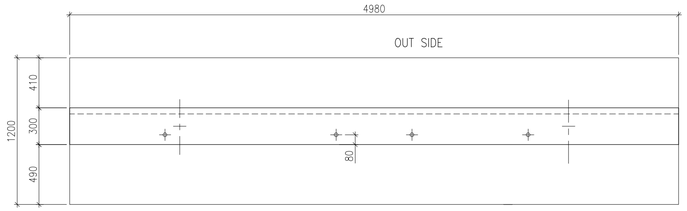
A0(841X1189mm +2mm)



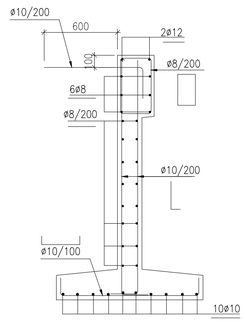
ELEVATION



SECTION-A



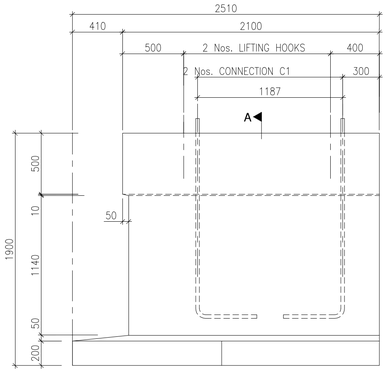
PLAN



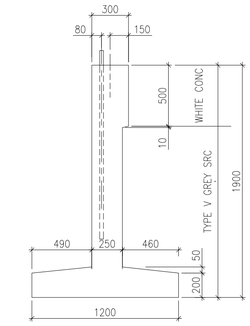
SECTION-A
SHOWING REINF.

FOOTING - F5H

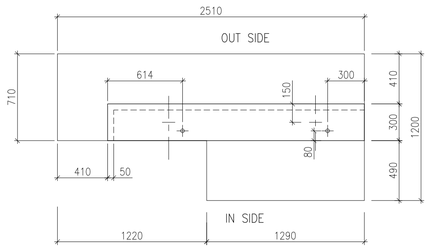
Nos. REQD. = 1 VOLUME 3.68 m³



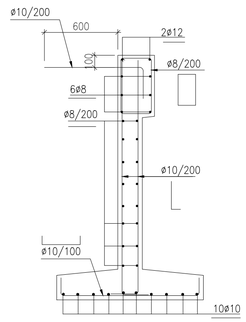
ELEVATION



SECTION-A



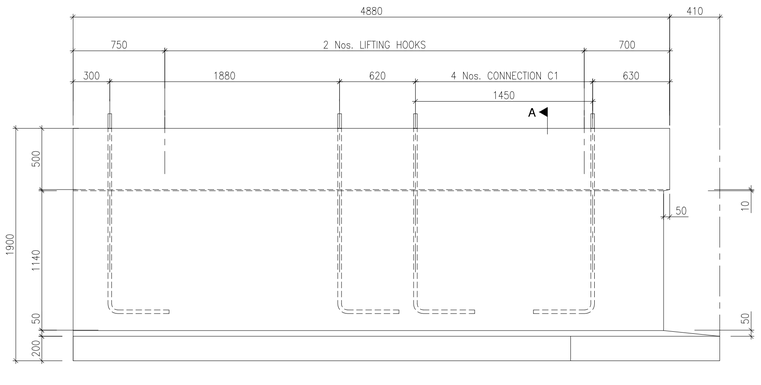
PLAN



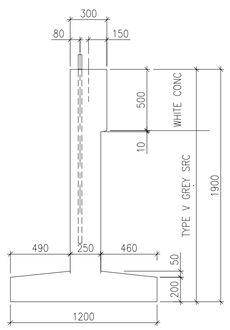
SECTION-A
SHOWING REINF.

FOOTING - F6

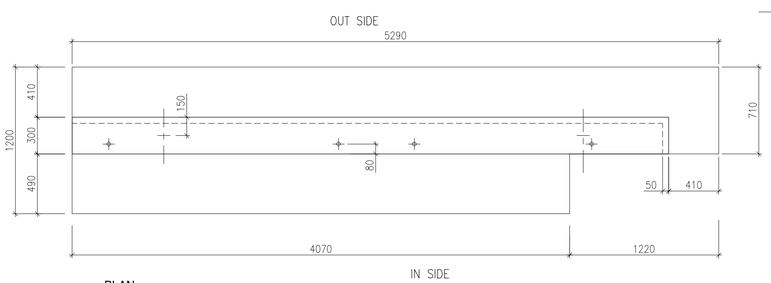
Nos. REQD. = 1 VOLUME 1.60 m³



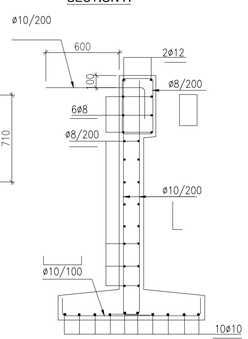
ELEVATION



SECTION-A



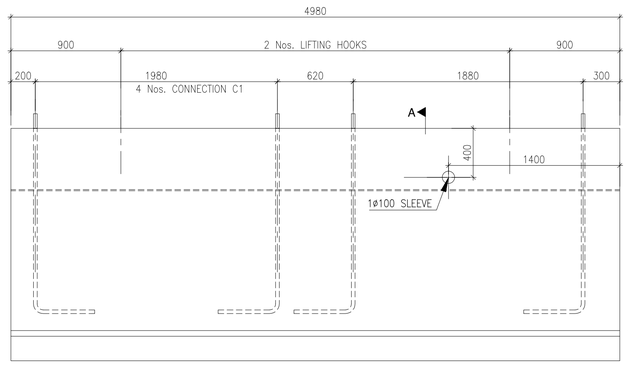
PLAN



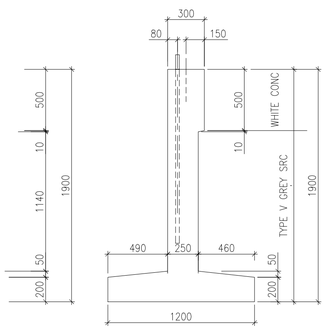
SECTION-A
SHOWING REINF.

FOOTING - F7H

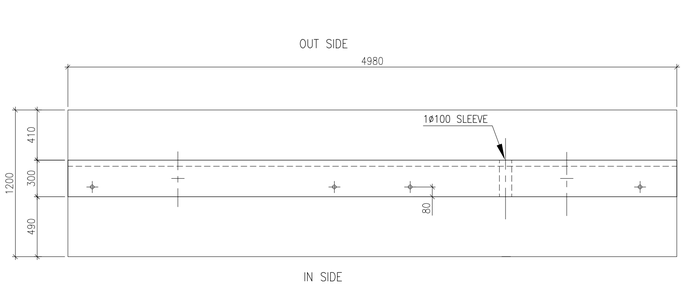
Nos. REQD. = 1 VOLUME 3.69 m³



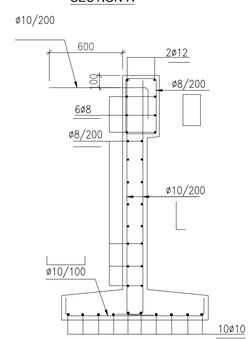
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F8H

Nos. REQD. = 1 VOLUME 3.68 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

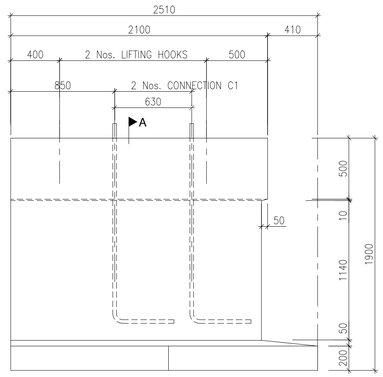
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

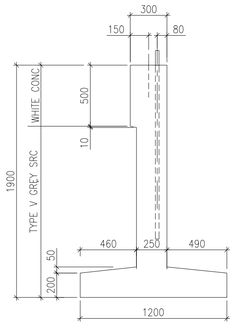
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65672-2
REV. C1

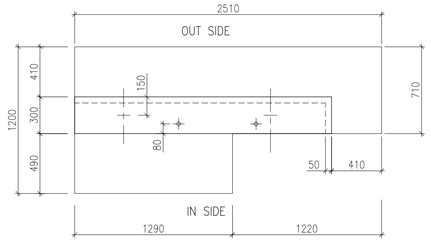
A0(841X1189mm +2mm)



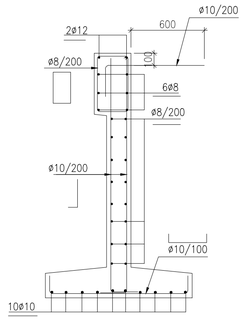
ELEVATION



SECTION-A



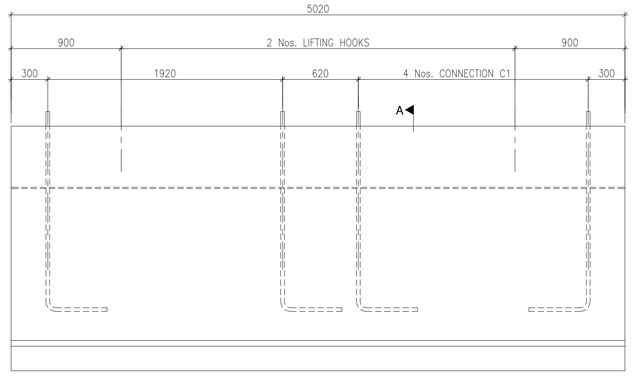
PLAN



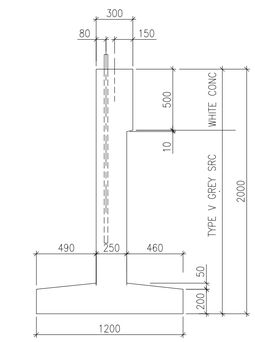
SECTION-A
SHOWING REINF.

FOOTING - F9

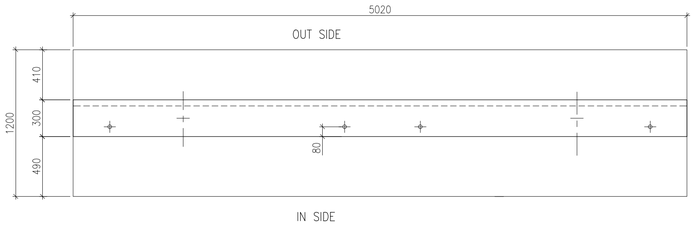
Nos. REQD. = 1 VOLUME 1.60 m³



ELEVATION



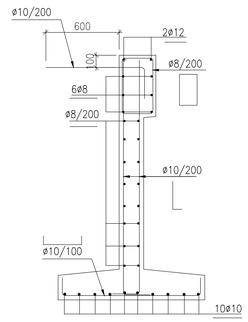
SECTION-A



PLAN

FOOTING - F10

Nos. REQD. = 2 VOLUME 3.78 m³



SECTION-A
SHOWING REINF.

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

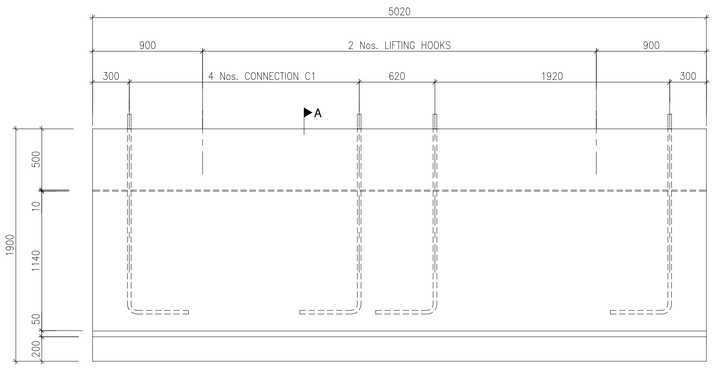
SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

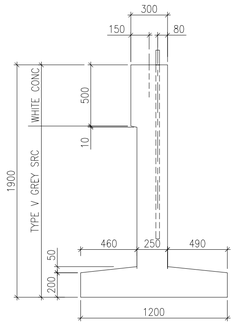
CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

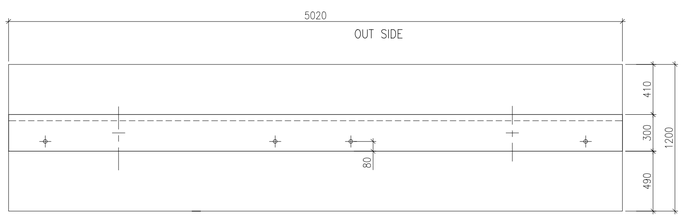
COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK



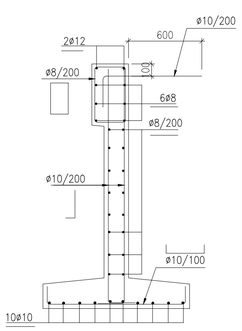
ELEVATION



SECTION-A



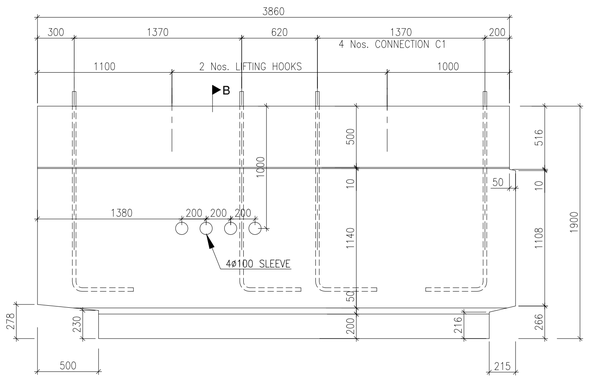
PLAN



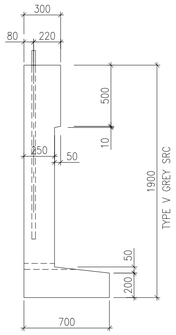
SECTION-A
SHOWING REINF.

FOOTING - F11

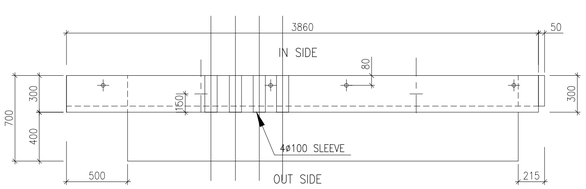
Nos. REQD. = 2 VOLUME 3.78 m³



ELEVATION



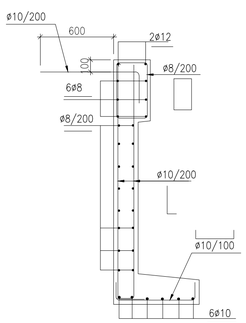
SECTION-B



PLAN

FOOTING - F16H

Nos. REQD. = 1 VOLUME 2.40 m³



SECTION-B
SHOWING REINF.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

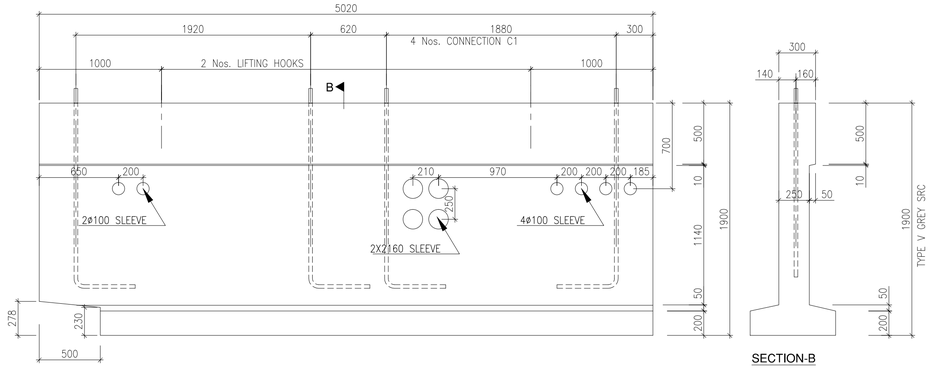
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65672-3

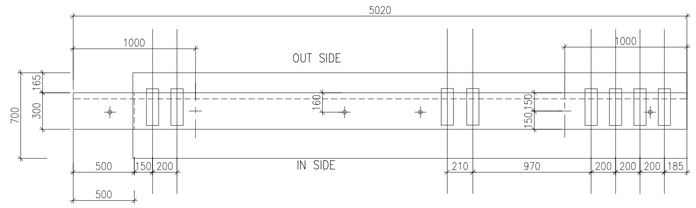
REV. C1

A0(841x1189mm + 2mm)

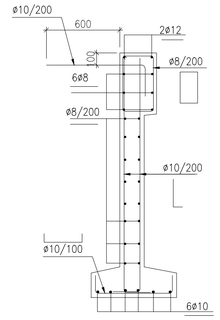


ELEVATION

SECTION-B



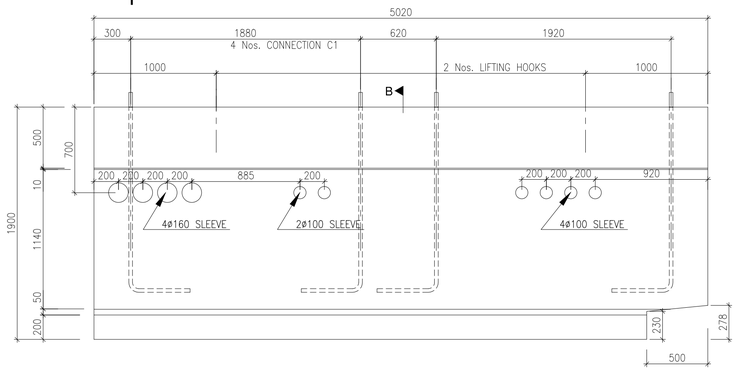
PLAN



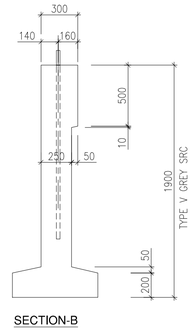
SECTION-B
SHOWING REINF.

FOOTING - F12H

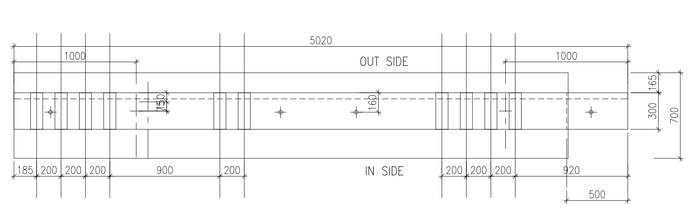
Nos. REQD. = 1 VOLUME 3.20 m³



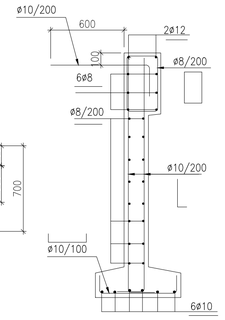
ELEVATION



SECTION-B



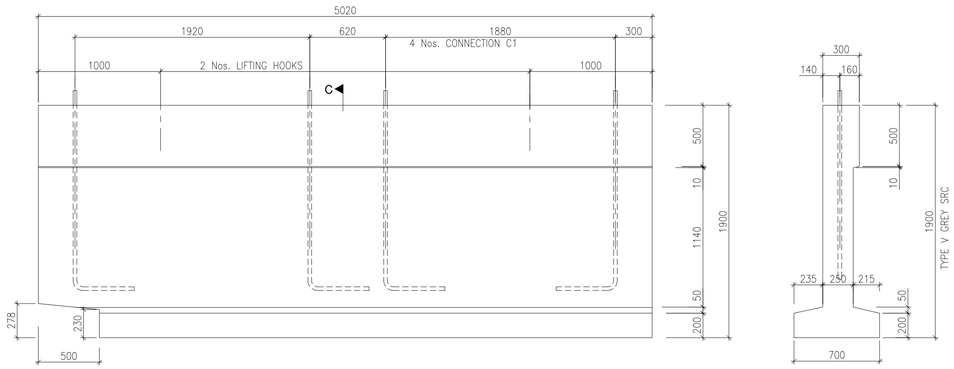
PLAN



SECTION-B
SHOWING REINF.

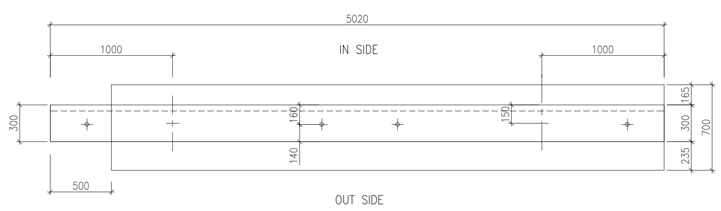
FOOTING - F13H

Nos. REQD. = 1 VOLUME 3.20 m³

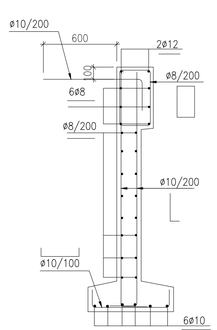


ELEVATION

SECTION-C



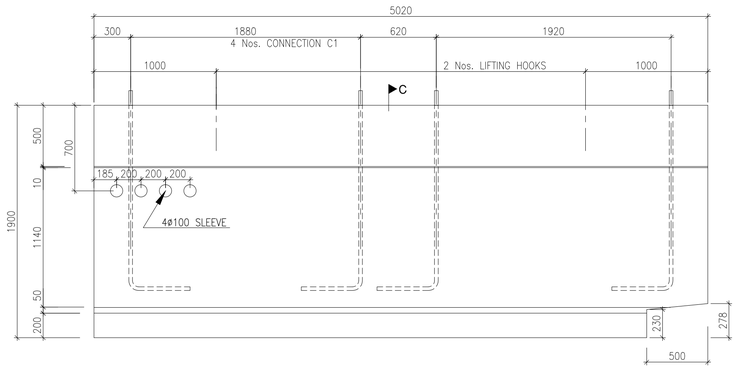
PLAN



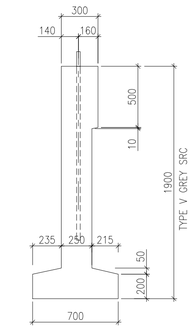
SECTION-C
SHOWING REINF.

FOOTING - F14H

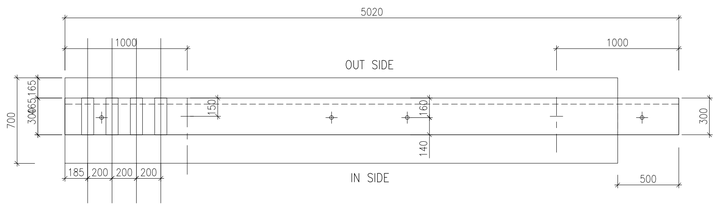
Nos. REQD. = 2 VOLUME 3.20 m³



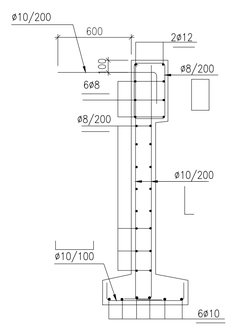
ELEVATION



SECTION-C



PLAN



SECTION-C
SHOWING REINF.

FOOTING - F15H

Nos. REQD. = 2 VOLUME 3.20 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

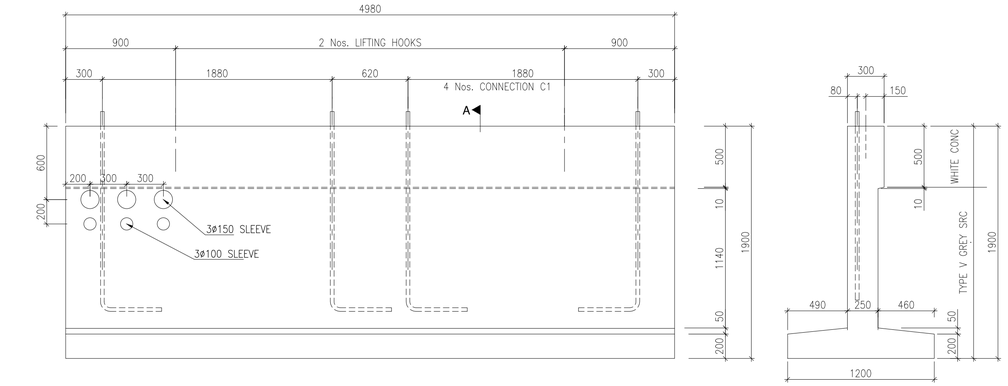
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65672-4

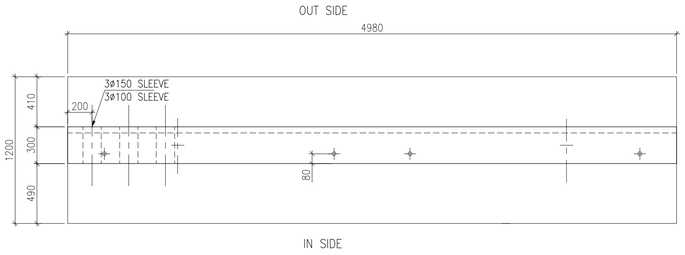
REV. C1

A0(841X1189mm + 2mm)

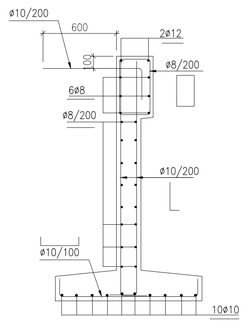


ELEVATION

SECTION-A



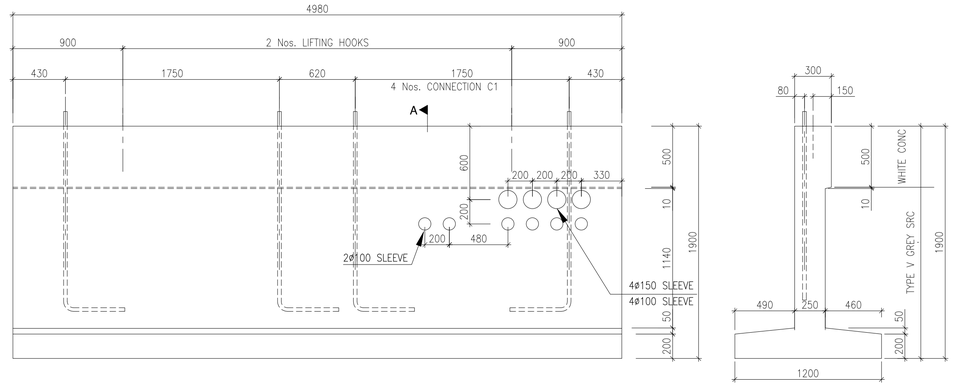
PLAN



SECTION-A
SHOWING REINF.

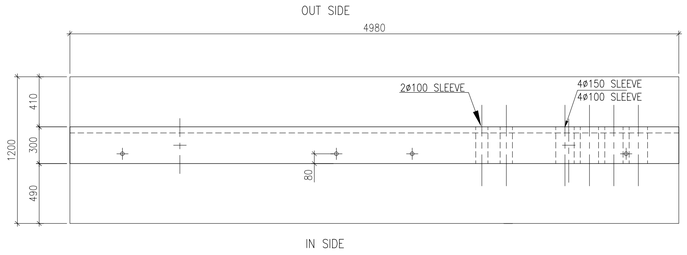
FOOTING - F2.1H

Nos. REQD. = 1 VOLUME 3.68 m³

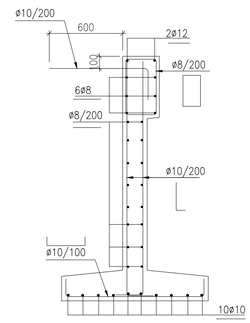


ELEVATION

SECTION-A



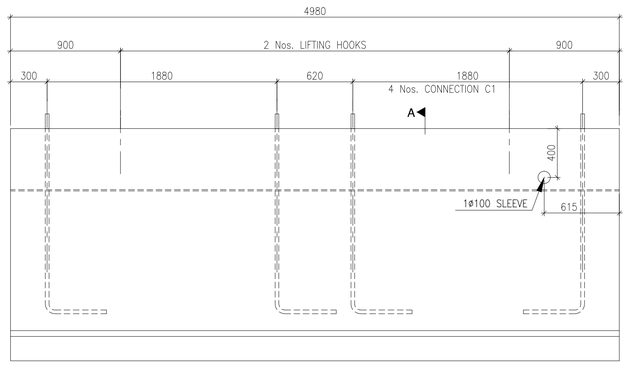
PLAN



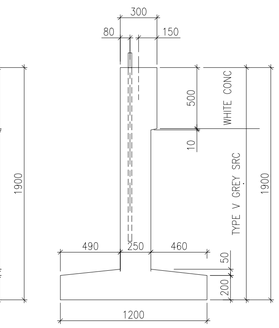
SECTION-A
SHOWING REINF.

FOOTING - F2.2H

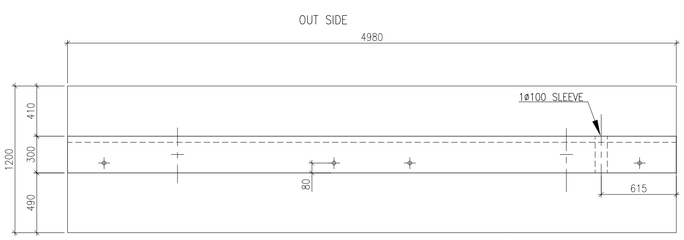
Nos. REQD. = 1 VOLUME 3.68 m³



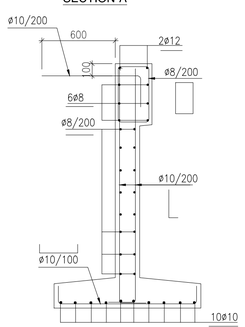
ELEVATION



SECTION-A



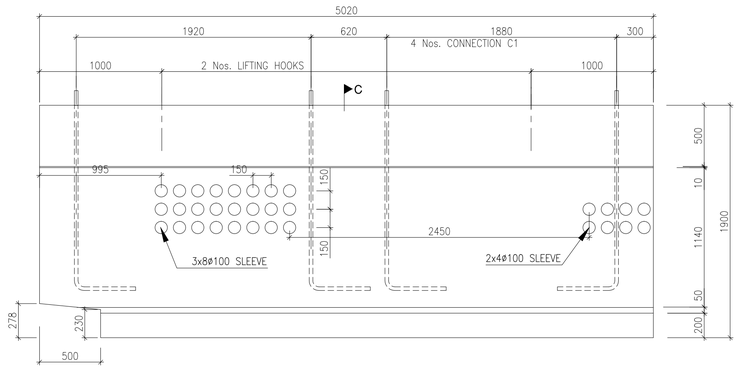
PLAN



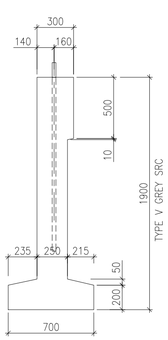
SECTION-A
SHOWING REINF.

FOOTING - F2.3H

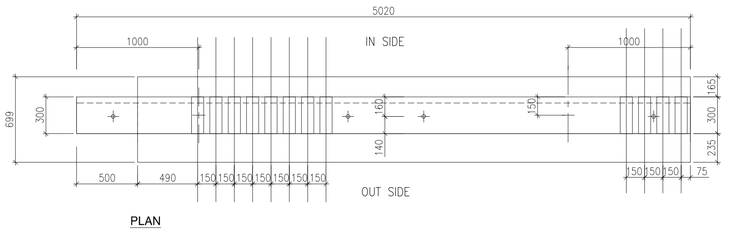
Nos. REQD. = 1 VOLUME 3.68 m³



ELEVATION



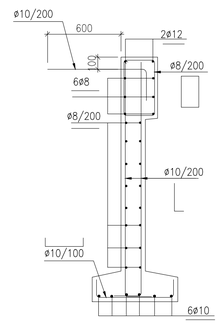
SECTION-C



PLAN

FOOTING - F14.1

Nos. REQD. = 1 VOLUME 3.20 m³



SECTION-C
SHOWING REINF.

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

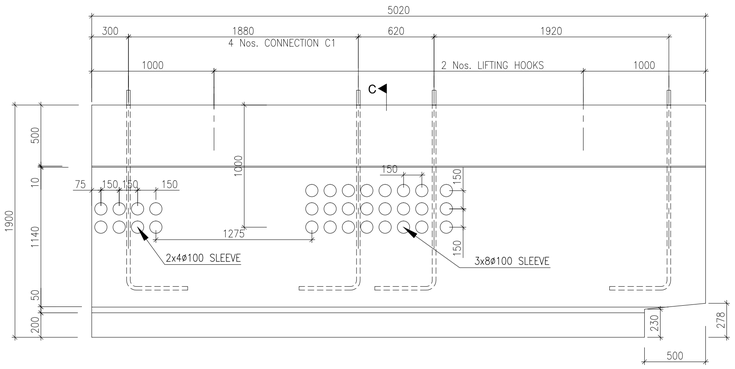
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

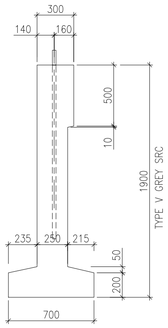
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65672-5
REV. C1

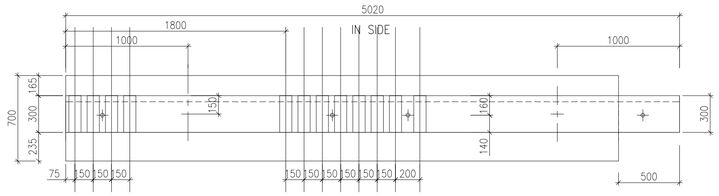
A0(841x1189mm + 2mm)



ELEVATION

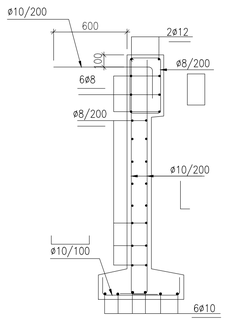


SECTION-C



OUT SIDE

PLAN



SECTION-C
SHOWING REINF.

FOOTING - F15.1

Nos. REQD. = 1 VOLUME 3.20 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NIRTH ISLAND SUBSTATION BSS 1
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

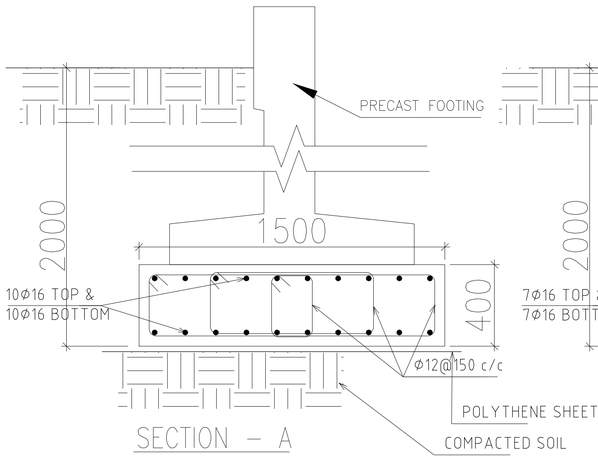
DRAWING NO.
RA140-32-BUI-CW-DW-65672-6

REV.
C1

A0(841X1189mm +2mm)

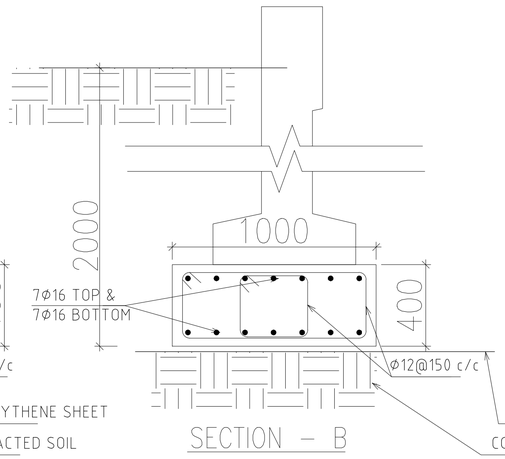
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.
2. 28 DAYS CUBE STRENGTH OF CONCRETE = 30 MPa.
3. USE CEMENT TYPE V (SRC) TO ASTM C150.
4. CLEAR COVER TO REINFORCEMENT = 50 mm.
5. REINFORCING STEEL GRADE 60 TO ASTM A615.



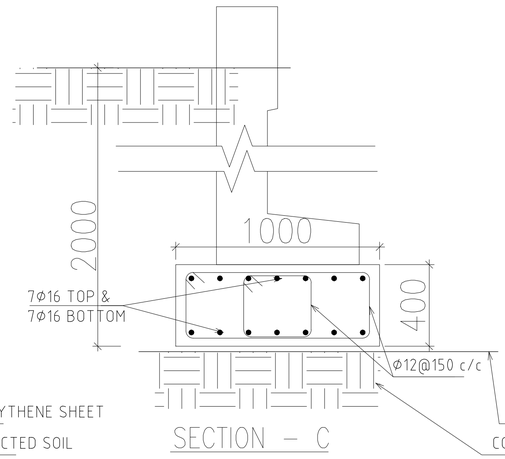
SECTION – A

TIE BEAM 1500 X 400 mm



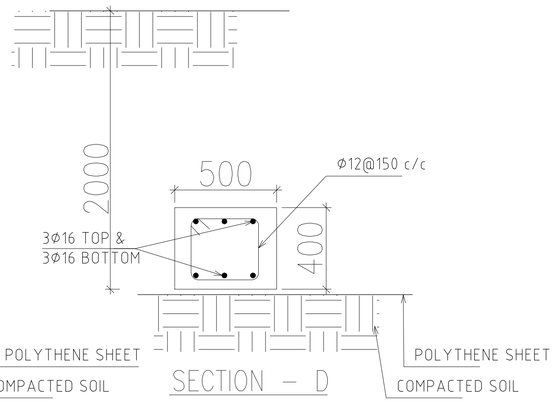
SECTION – B

TIE BEAM 1000 X 400 mm



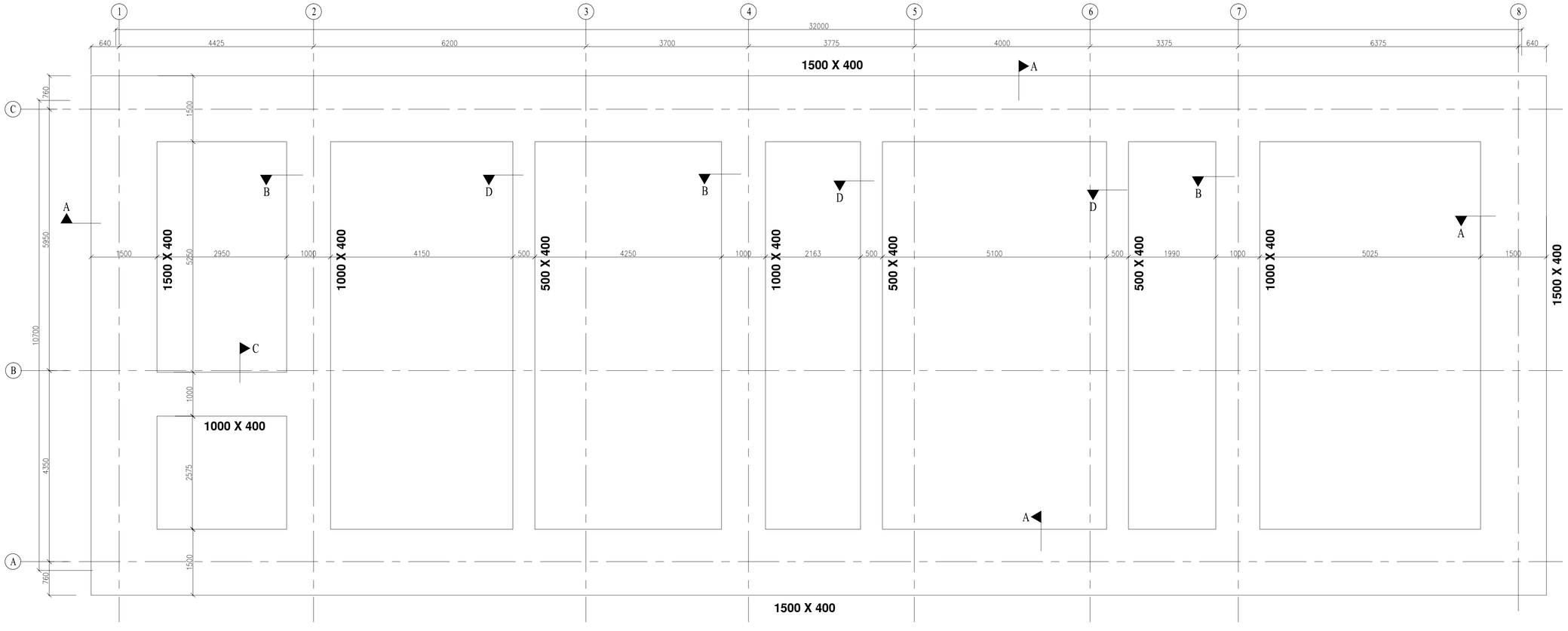
SECTION – C

TIE BEAM 1000 X 400 mm



SECTION – D

TIE BEAM 500 X 400 mm



CAST IN SITU RCC TIE BEAM - PLAN

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
CAST- IN SITU RCC TIE BEAM DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

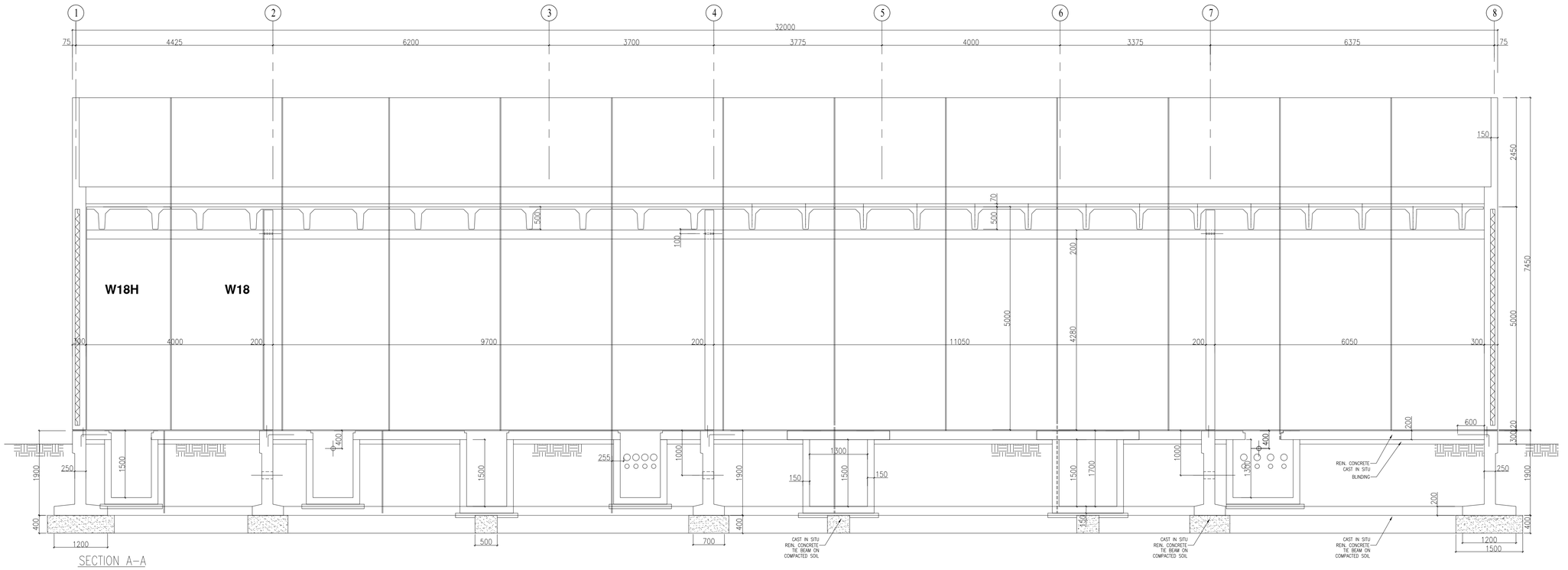
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

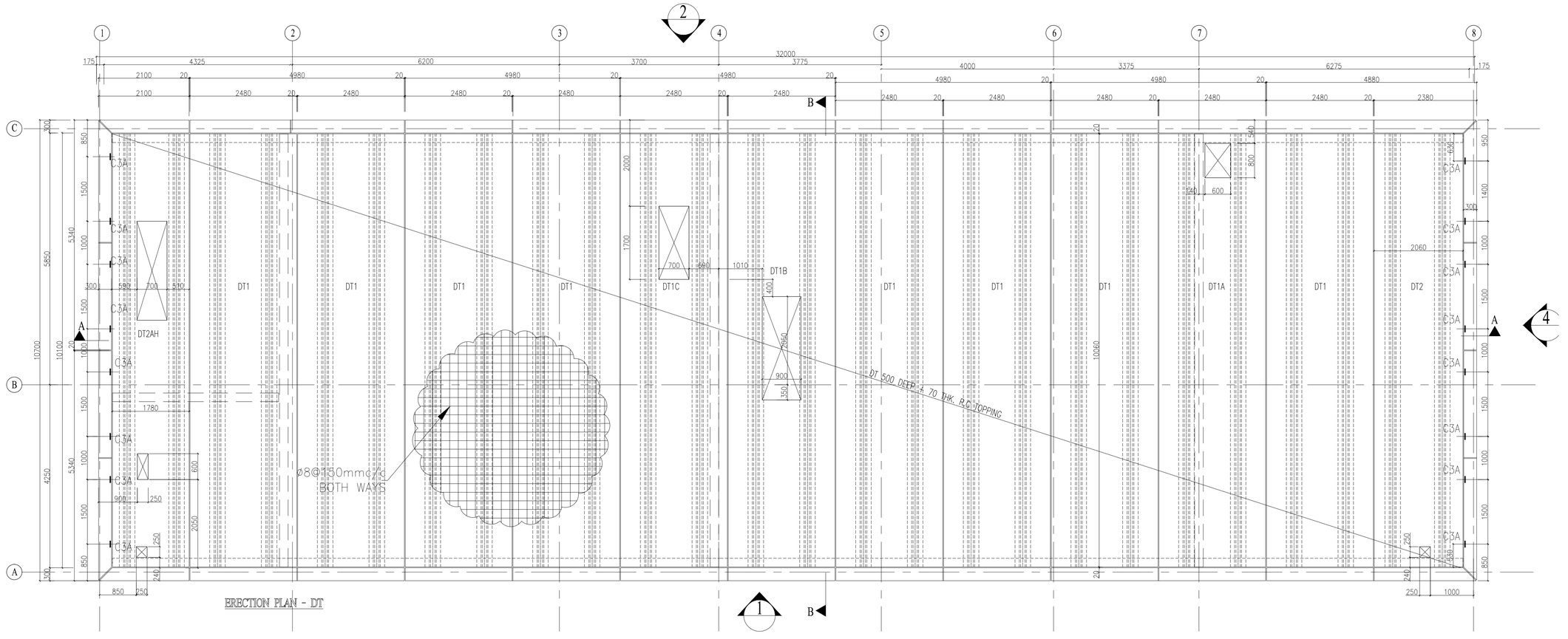
DRAWING NO.	REV.
RA140-32-BUI-CW-DW-65673	C1

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



SECTION A-A



ERECTION PLAN - DT

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ERECTION PLAN DT & SECTION A-A

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

PRECAST SUPPLIER

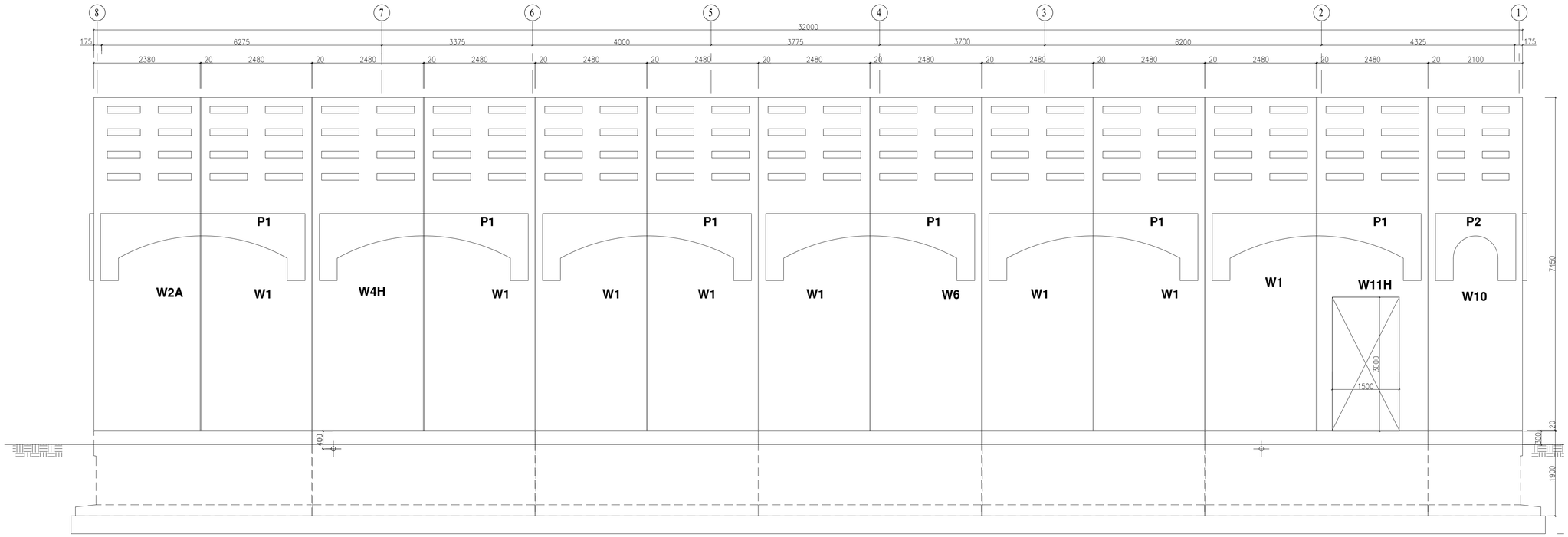
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.	REV.
RA140-32-BUI-CW-DW-65674	C1

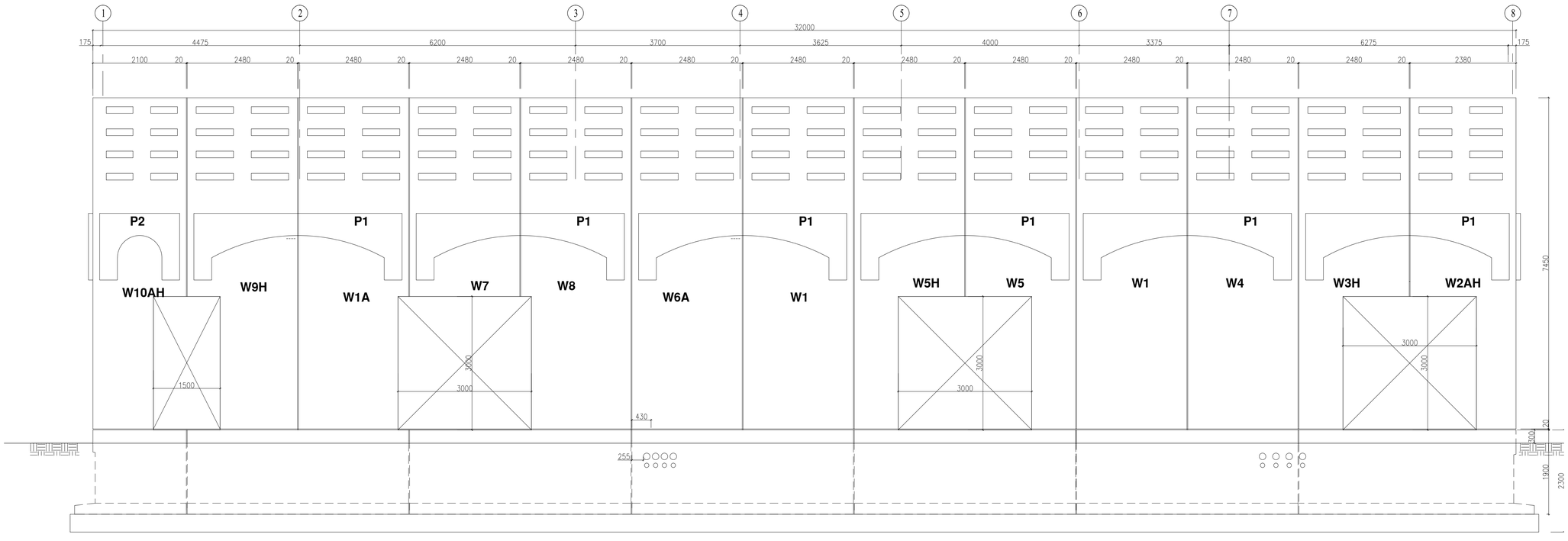
A0(841x1189mm +27mm)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



ELEVATION –2



ELEVATION –1

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ELEVATIONS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX :24478, SAFAT :13105, KUWAIT. TEL:23260054, FAX :23260067.

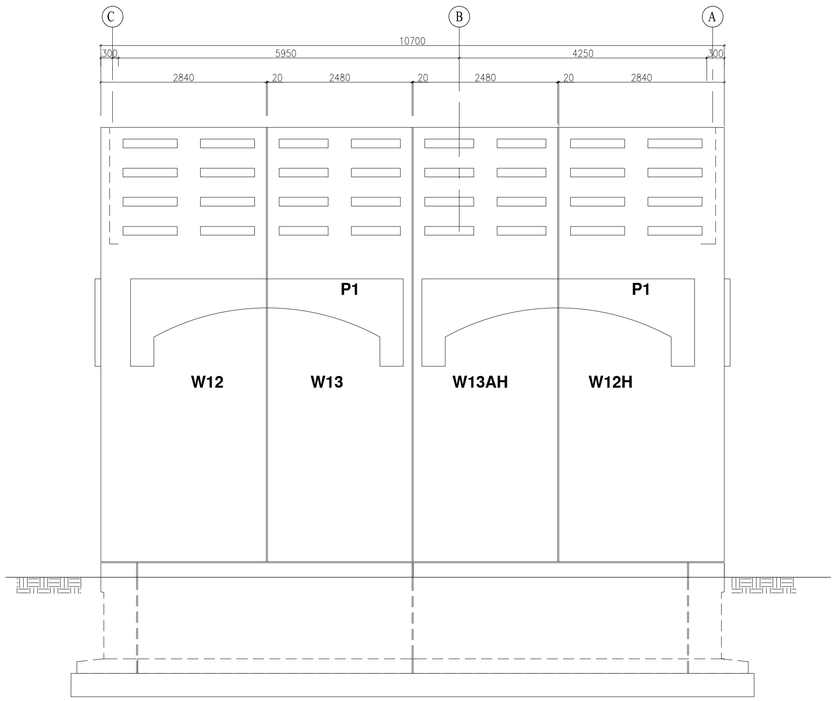
DRAWING NO. RA140-32-BUI-CW-DW-65675-1

REV. C1

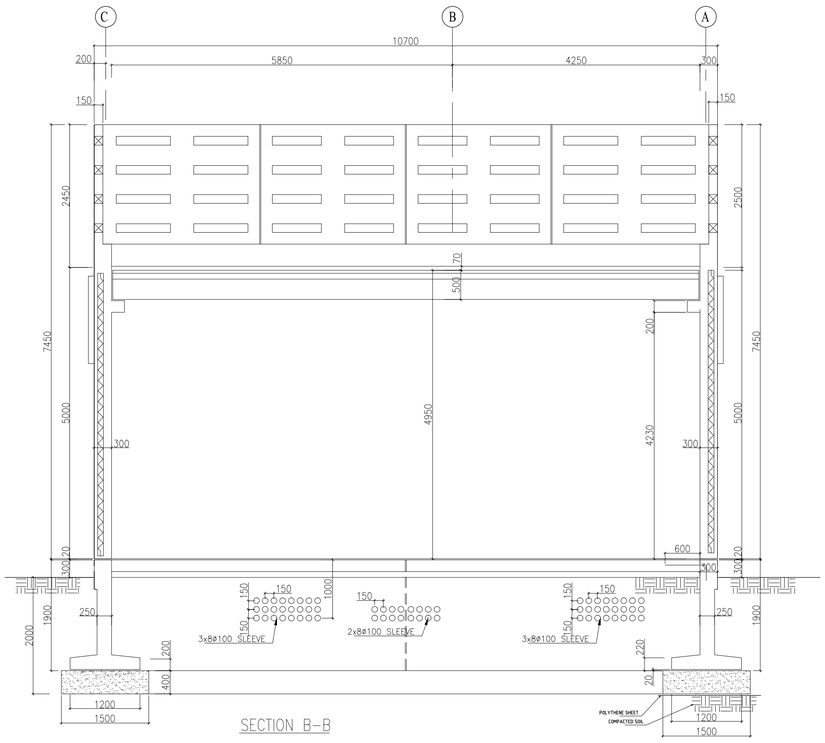
A0(841x1197mm +2mm)

NOTES

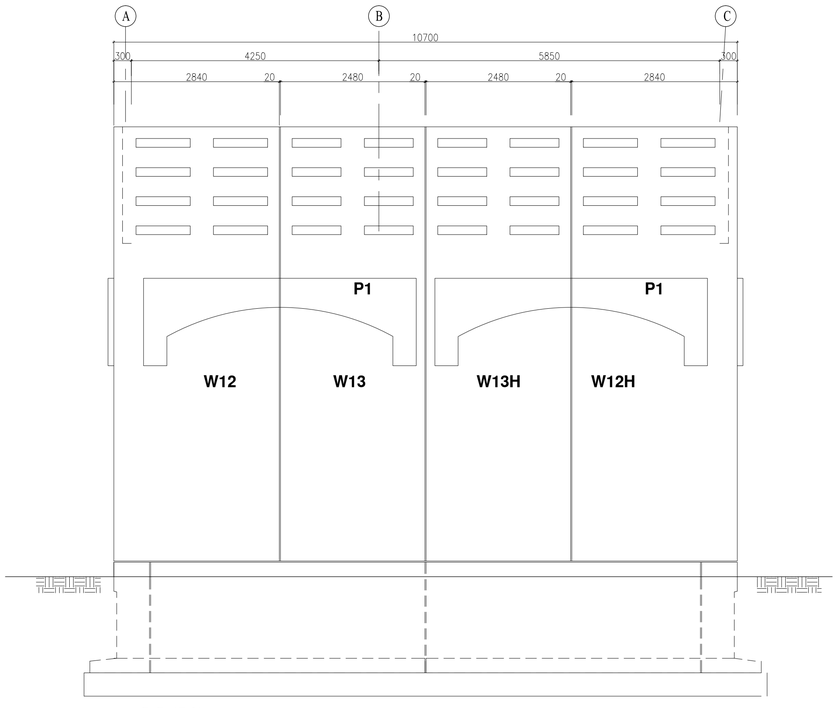
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



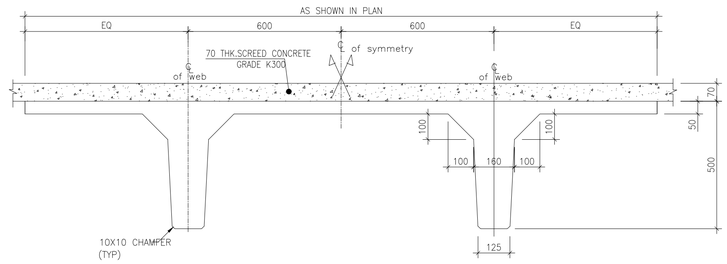
ELEVATION –3



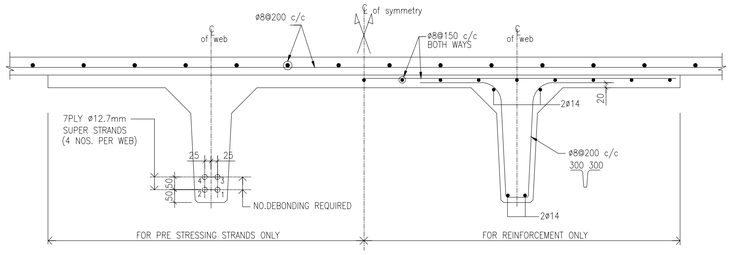
SECTION B–B



ELEVATION –4



SECTION 1-1
(SHOWING DIMENSIONS)
SCALE – 1:10



SECTION 1-1
(SHOWING R/F. & STRANDS)
SCALE – 1:10

DOUBLE TEE DETAILS (TYP.)

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ELEVATIONS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

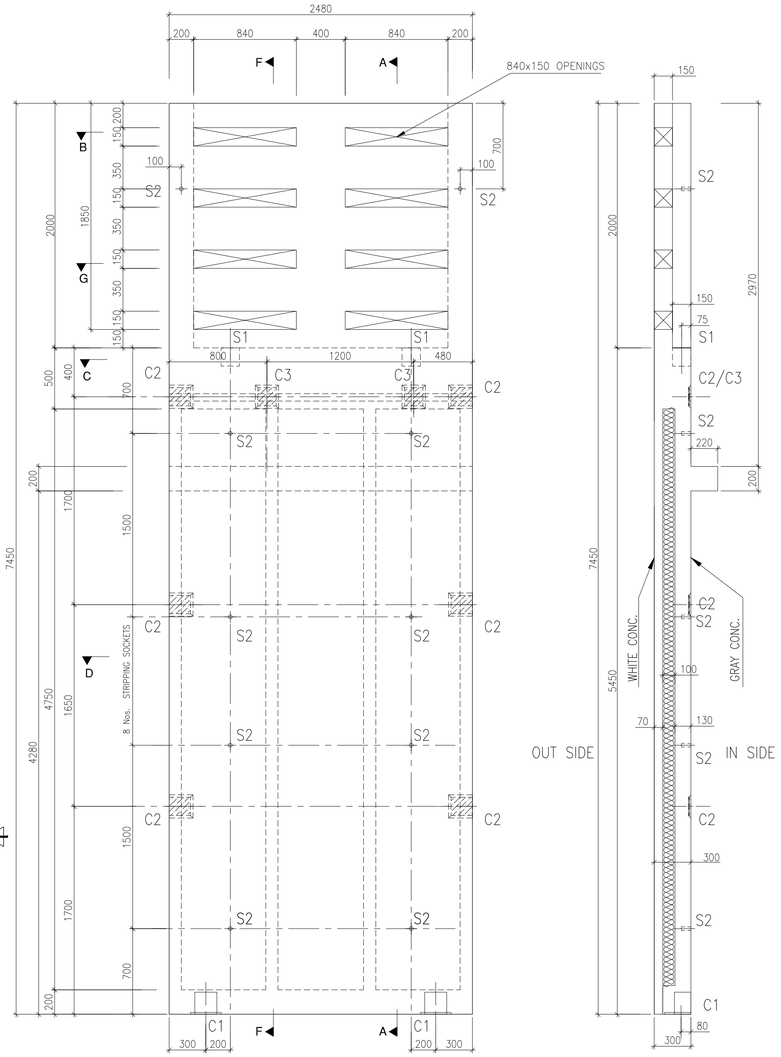
DRAWING NO.

RA140-32-BUI-CW-DW-65575-2

REV.

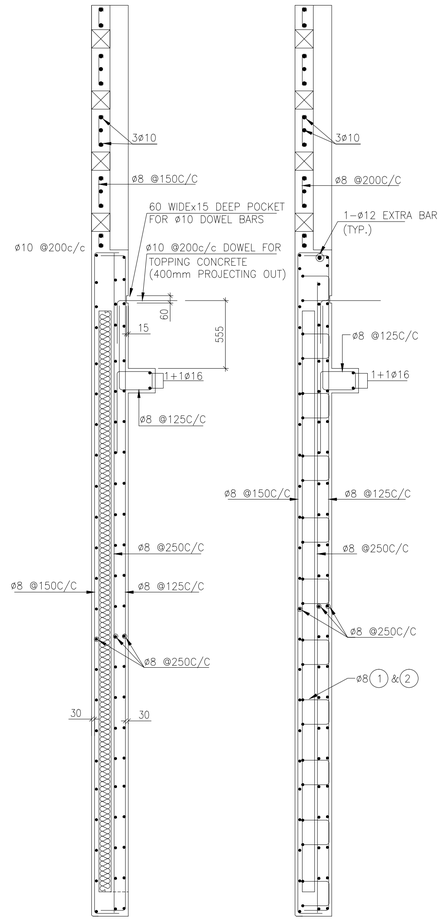
C1

A0(841x1189mm +Z5mm)



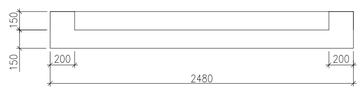
ELEVATION

SECTION A-A

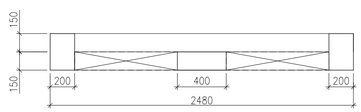


SECTION A-A
(SHOWING REINFORCEMENT)

SECTION F-F
(SHOWING REINFORCEMENT)

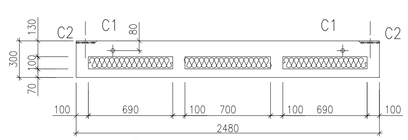


SECTION-G



SECTION-B

SECTION-C

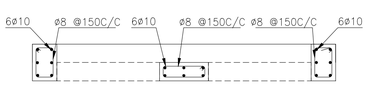


SECTION-D

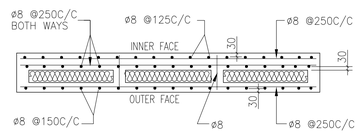
WALL- W1

Nos. REQD. = 10 VOLUME 4.62 m³

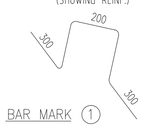
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS



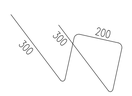
SECTION-B
(SHOWING REINF.)



SECTION-D
(SHOWING REINF.)



BAR MARK (1)
FOR INTERMEDIATE RIBS



BAR MARK (2)
FOR END RIBS

ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL RED OXIDE PAINTED.

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

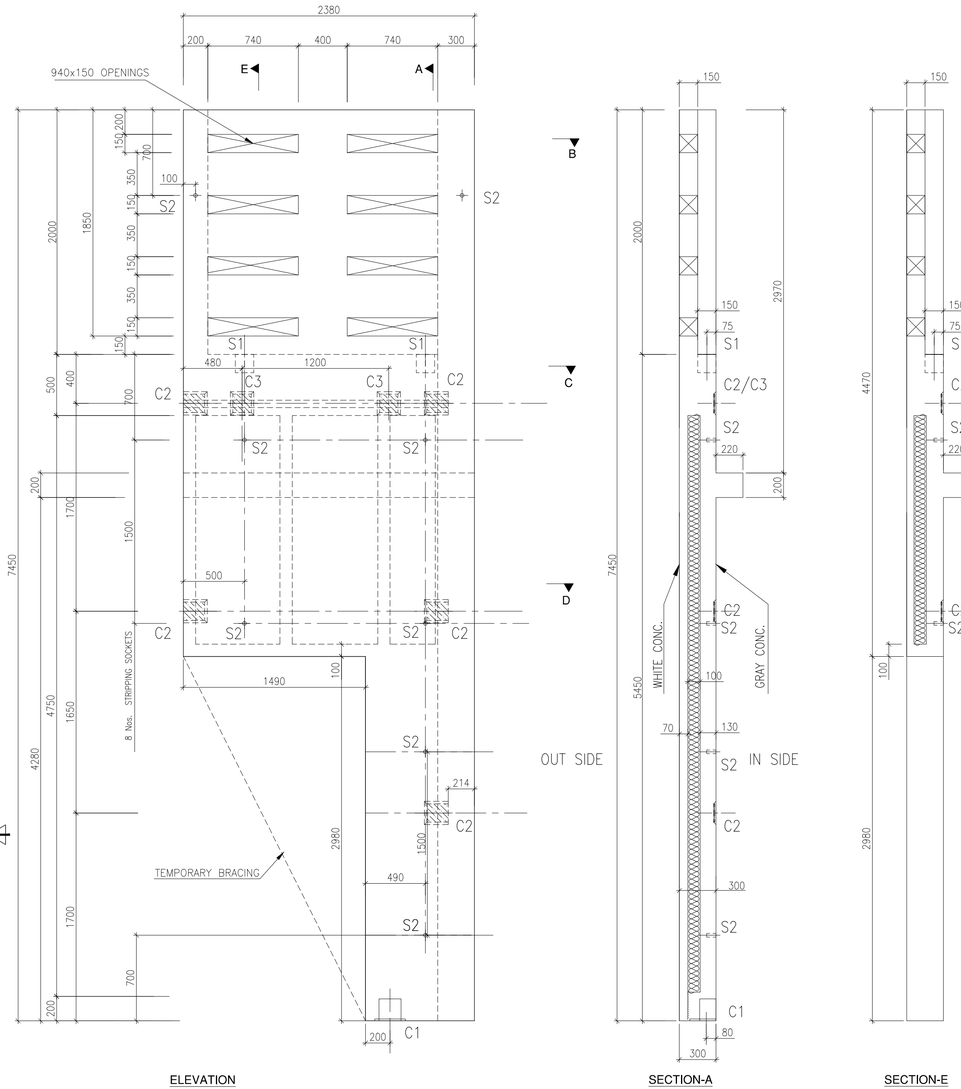
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

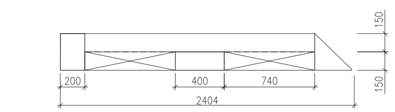
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

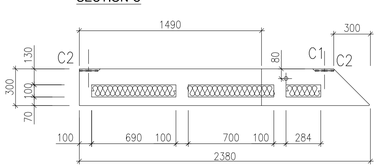
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65676-1
REV. C1

A0(841X1189mm =2m²)





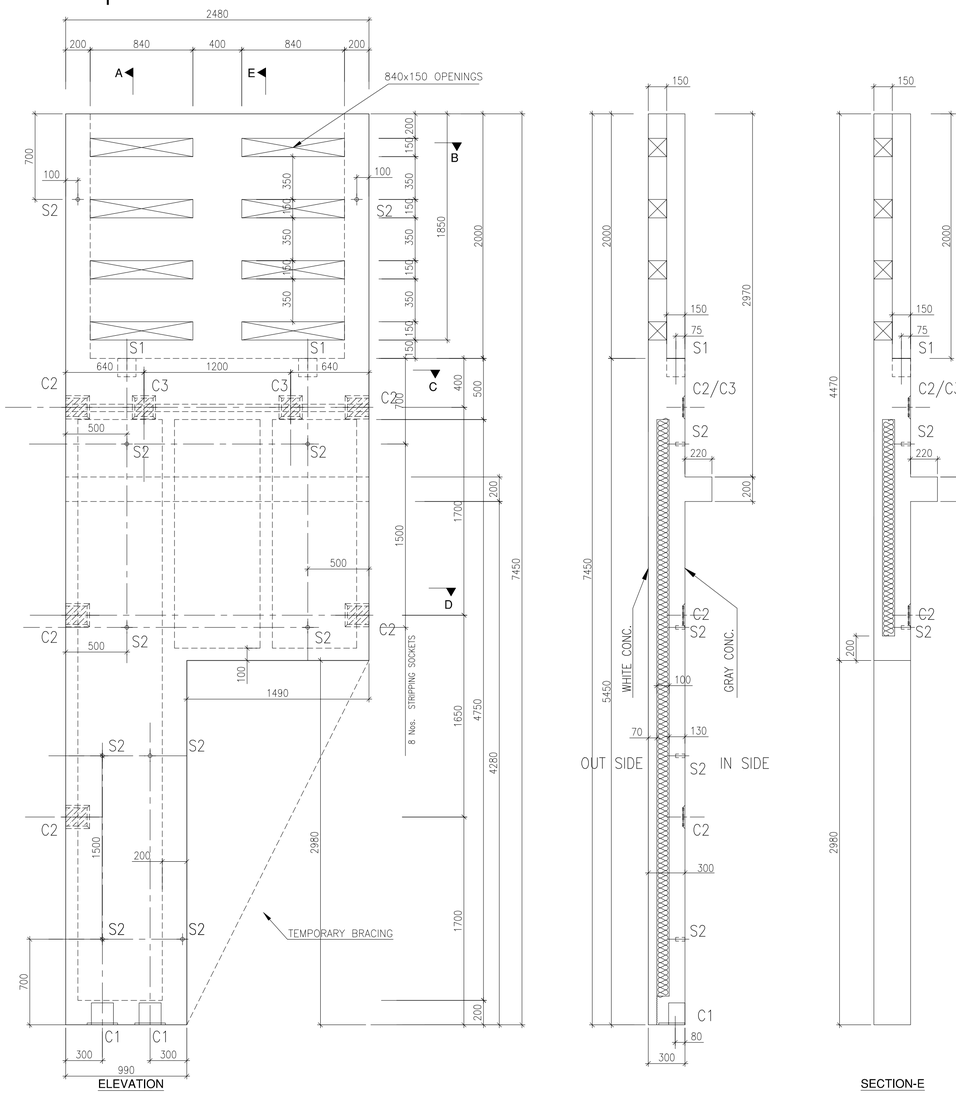


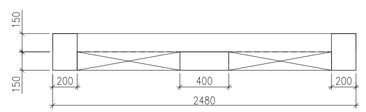
C1– 1 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

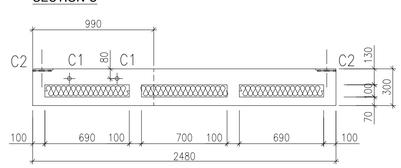
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W2AH

Nos. REQD. = 1 VOLUME 3.60 m³







C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W3H

Nos. REQD. = 1 VOLUME 3.52 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

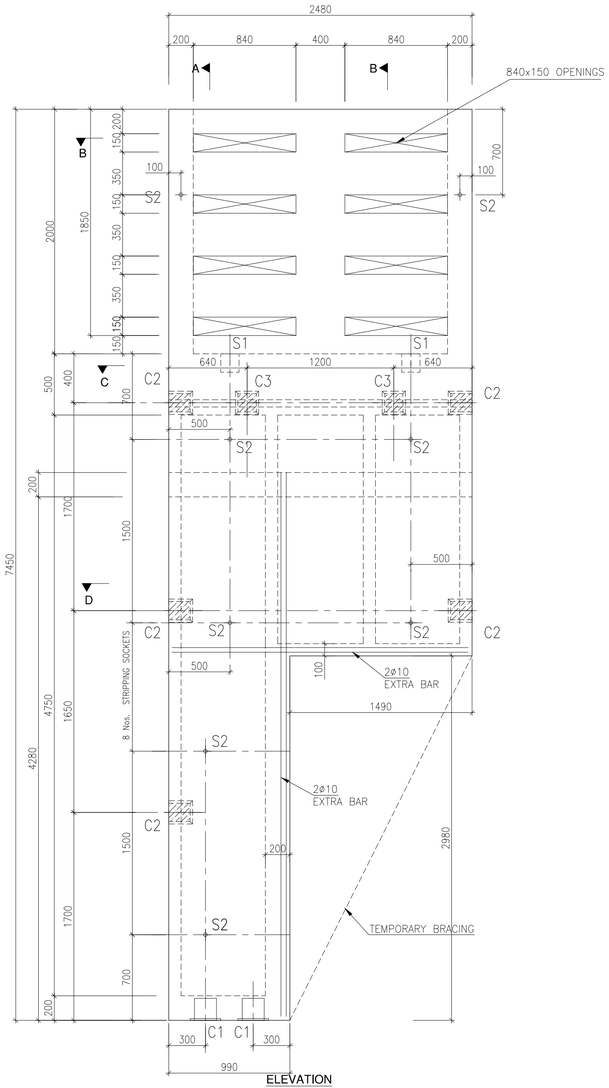
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

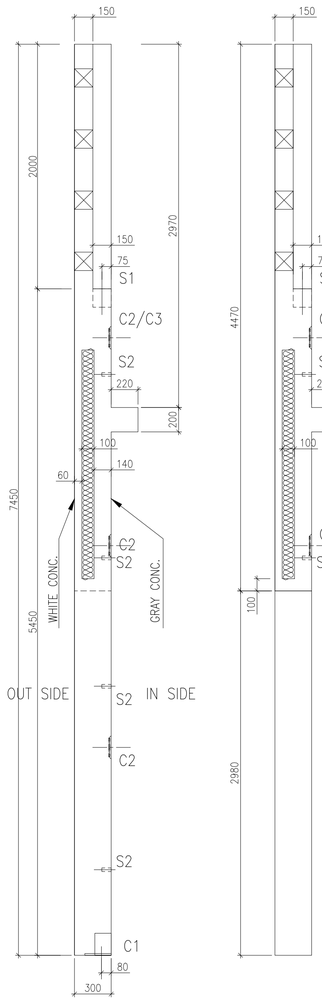
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067

DRAWING NO. RA140-32-BUI-CW-DW-65676-2
REV. C1

A0(841X1189mm + 2mm)

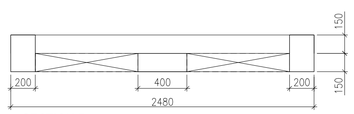


ELEVATION

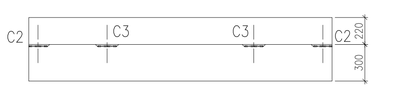


SECTION-A

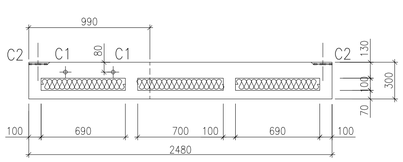
SECTION-B



SECTION-B



SECTION-C



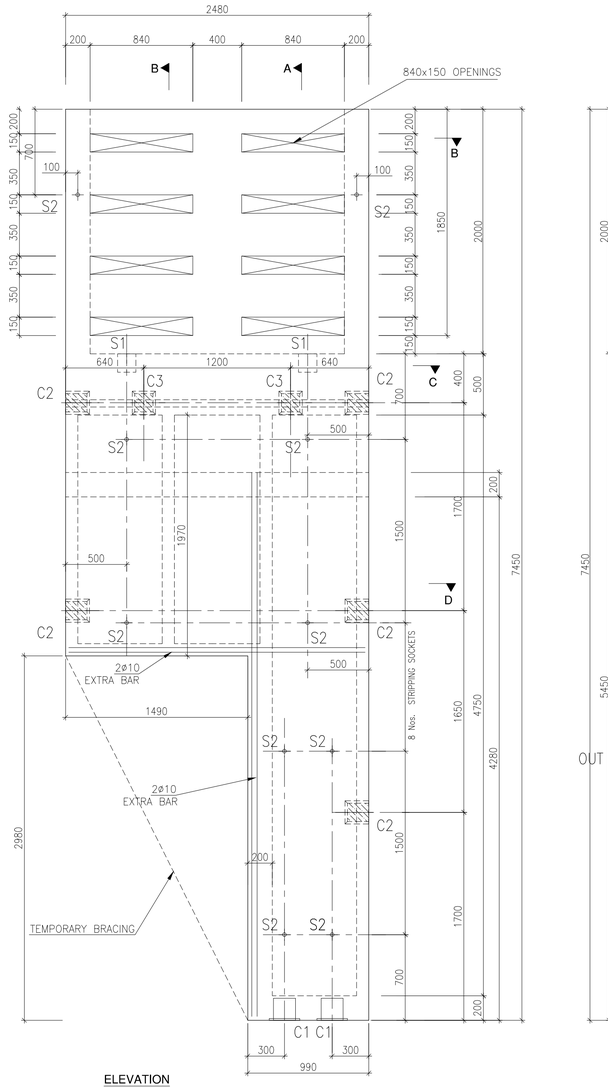
SECTION-D

WALL- W5

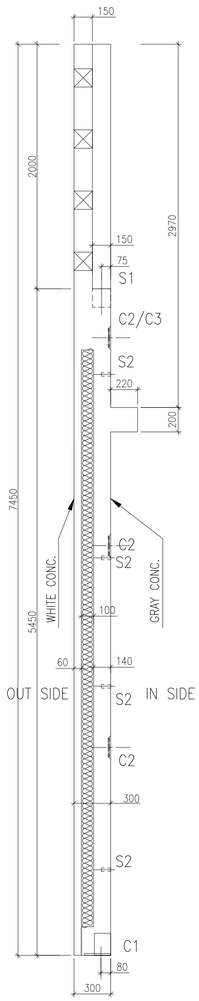
Nos. REQD. = 1 VOLUME 3.52 m³

C1– 1 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

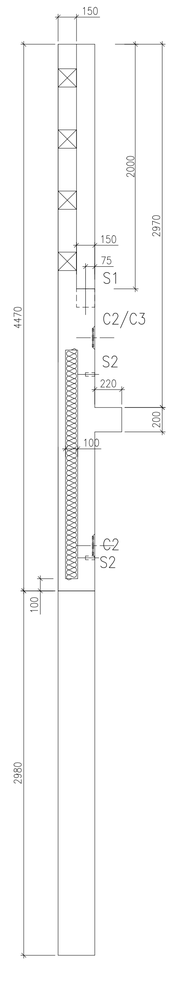
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



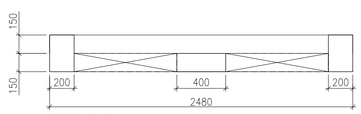
ELEVATION



SECTION-A

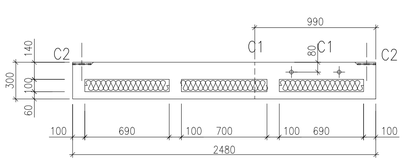


SECTION-B



SECTION-B

SECTION-C



SECTION-D

WALL- W5H

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

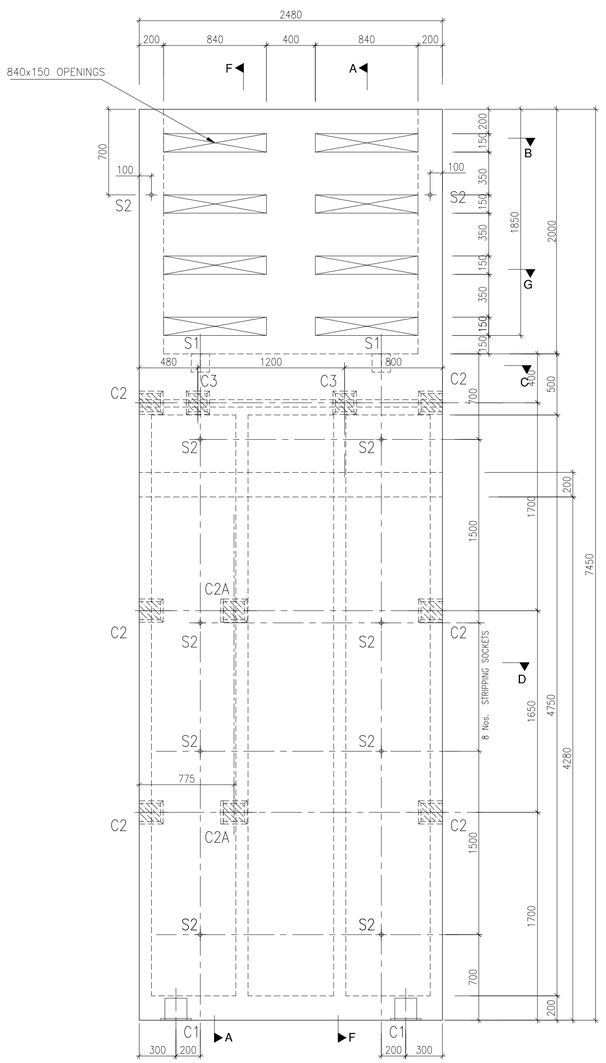
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

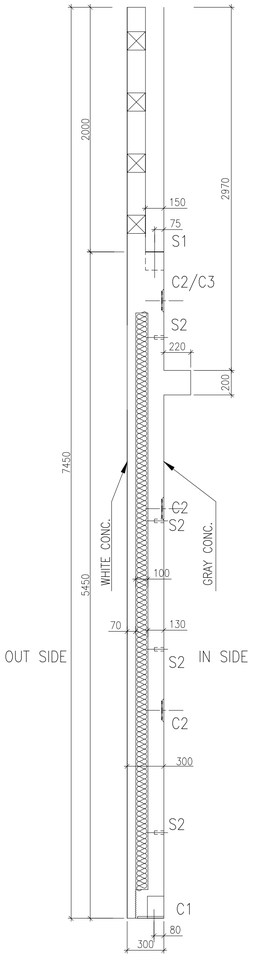
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65676-3
REV. C1

A0(841x1189mm +2mm)

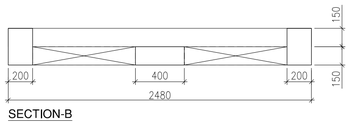


ELEVATION



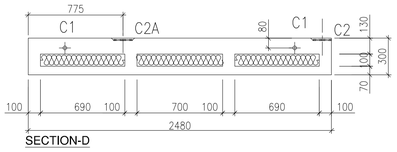
SECTION A-A

SECTION-G



SECTION-B

SECTION-C



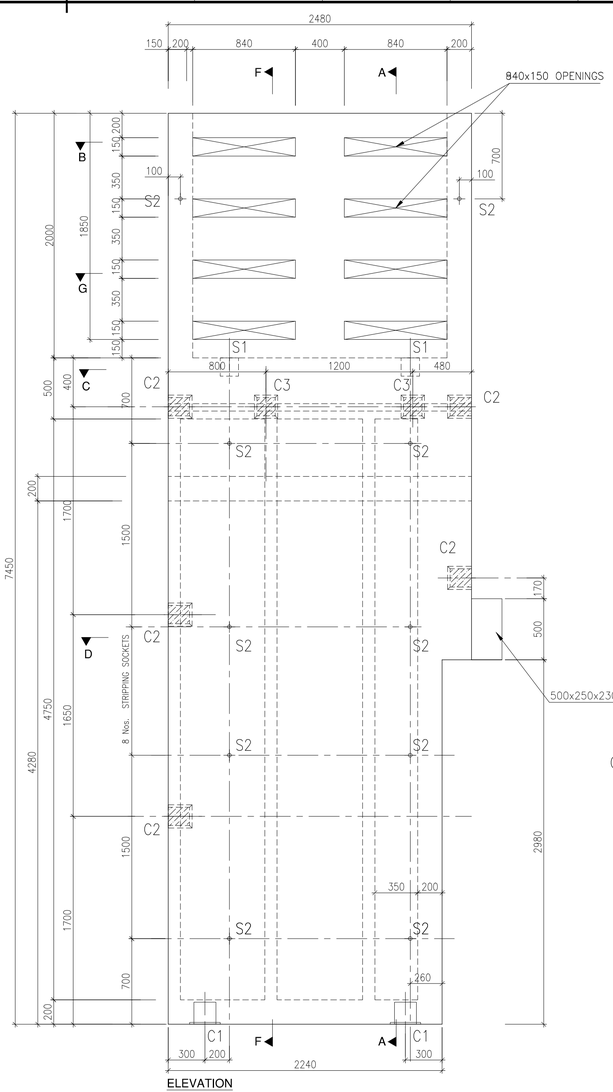
SECTION-D

WALL- W4H

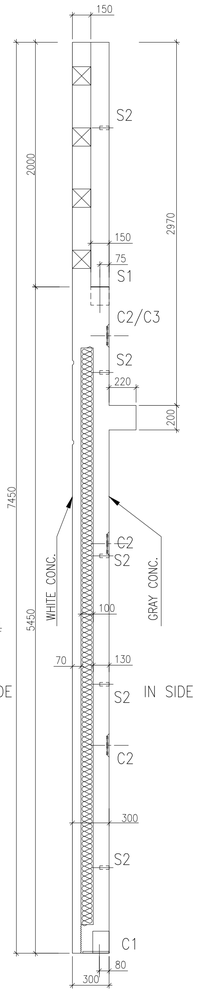
Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

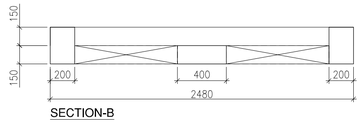


ELEVATION

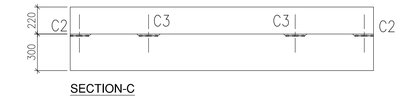


SECTION A-A

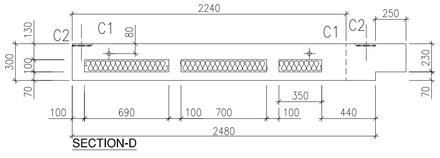
SECTION-G



SECTION-B



SECTION-C



SECTION-D

WALL- W1A

Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

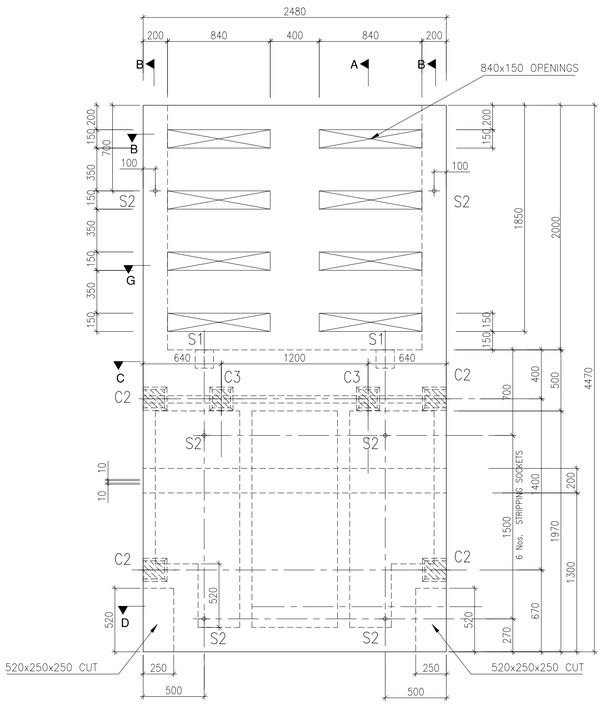
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17
02.07.17				

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

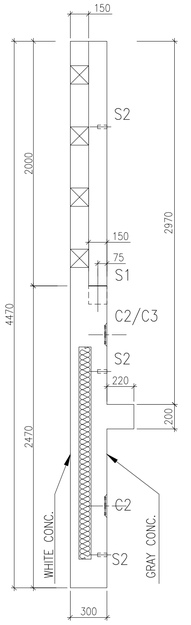
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL:23260054, FAX :23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65676-4
REV. C1

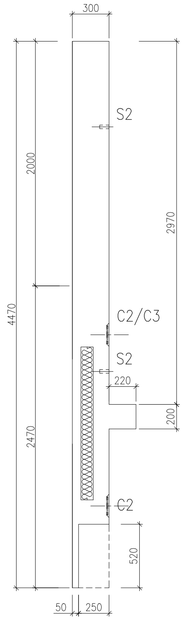
A0(841X1197mm +2mm)



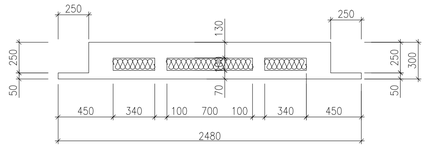
ELEVATION



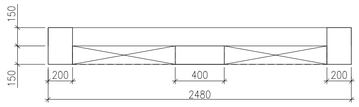
SECTION - A



SECTION -B



SECTION-D



SECTION-B

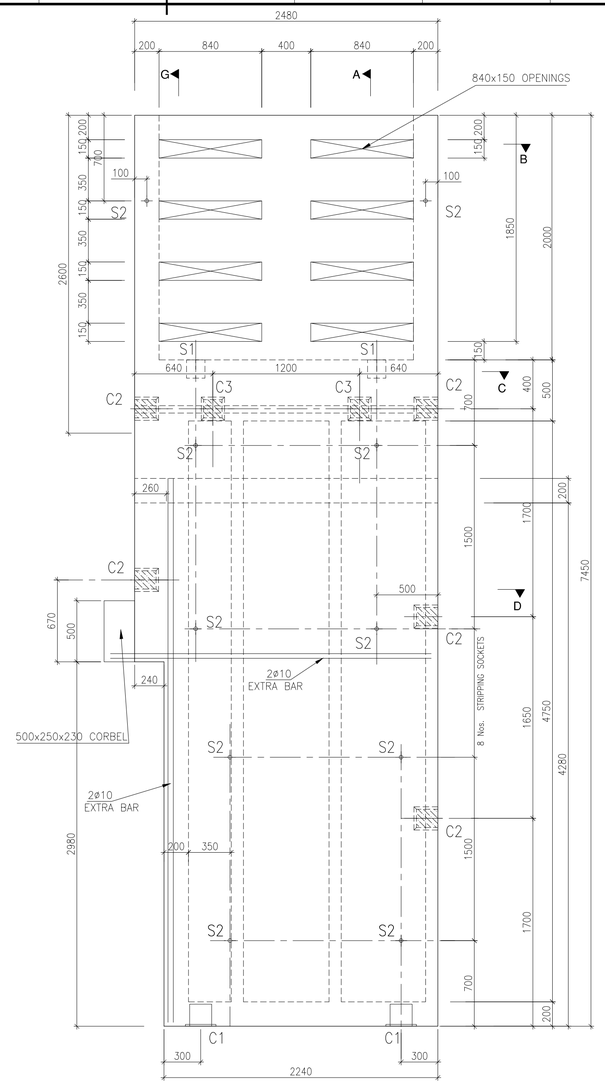
SECTION-C

WALL- W7

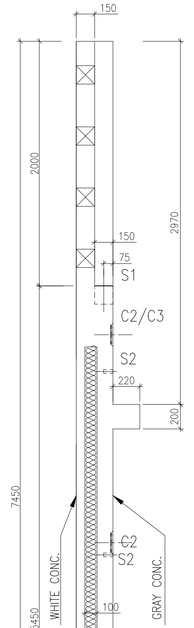
Nos. REQD. = 1 VOLUME 2.40 m³

C2– 4 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 6 No STRIPPING SOCKETS

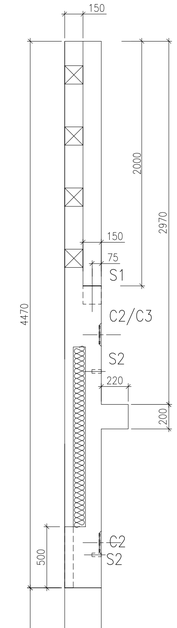
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



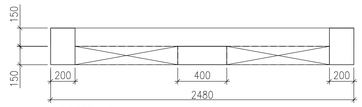
ELEVATION



SECTION-A

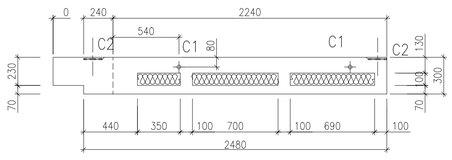


SECTION-G



SECTION-B

SECTION-C



SECTION-D

WALL- W8

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

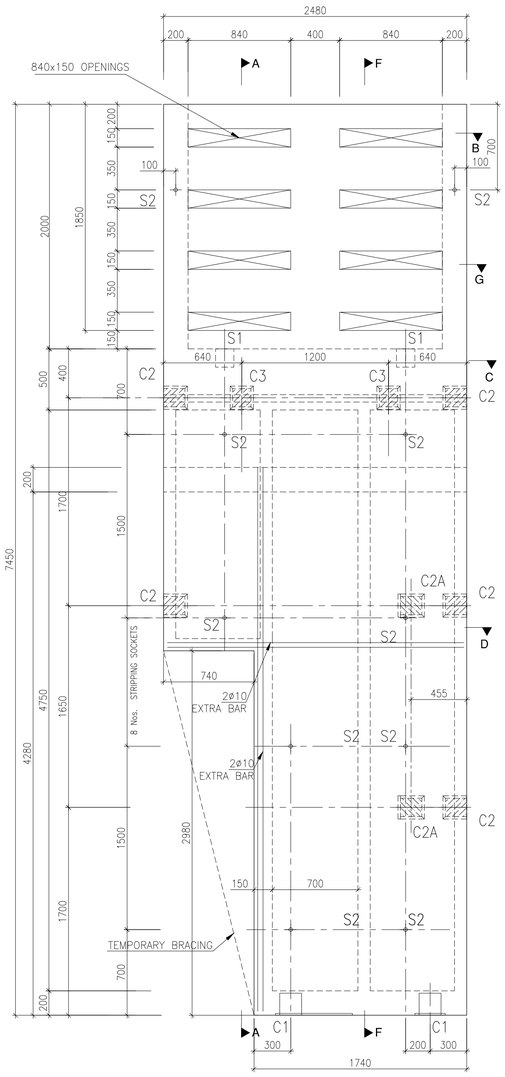
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

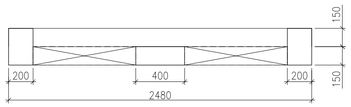
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067

DRAWING NO. RA140-32-BUI-CW-DW-65676-5
REV. C1

A0(841X1189mm +2mm)

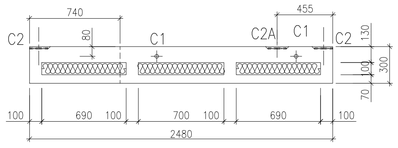


ELEVATION



SECTION-B

SECTION-C



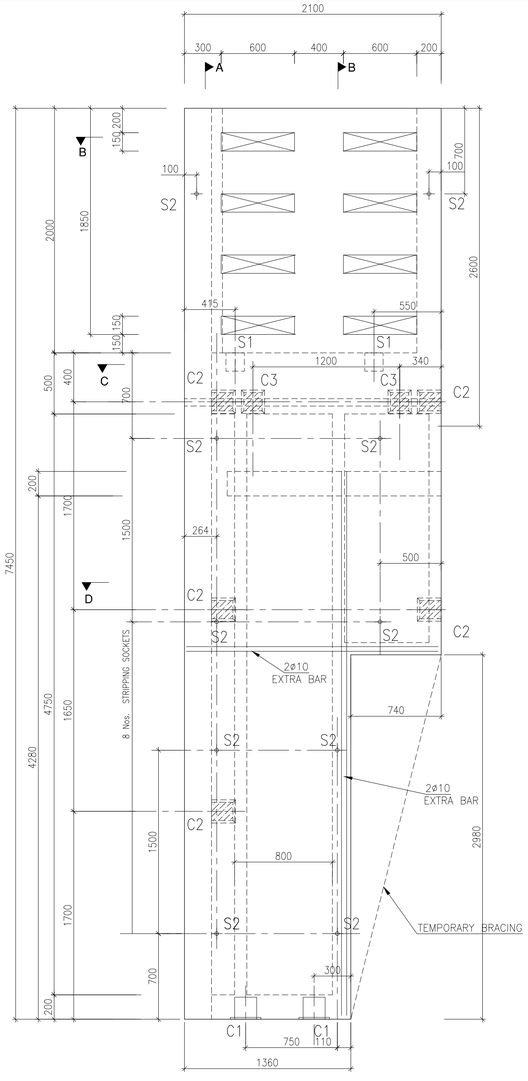
SECTION-D

WALL- W9H

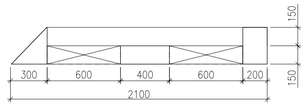
Nos. REQD. = 1 VOLUME 3.79 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

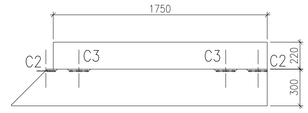
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



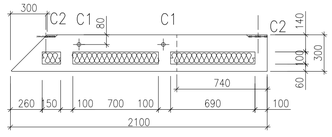
ELEVATION



SECTION-B



SECTION-C



SECTION-D

WALL- W10AH

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

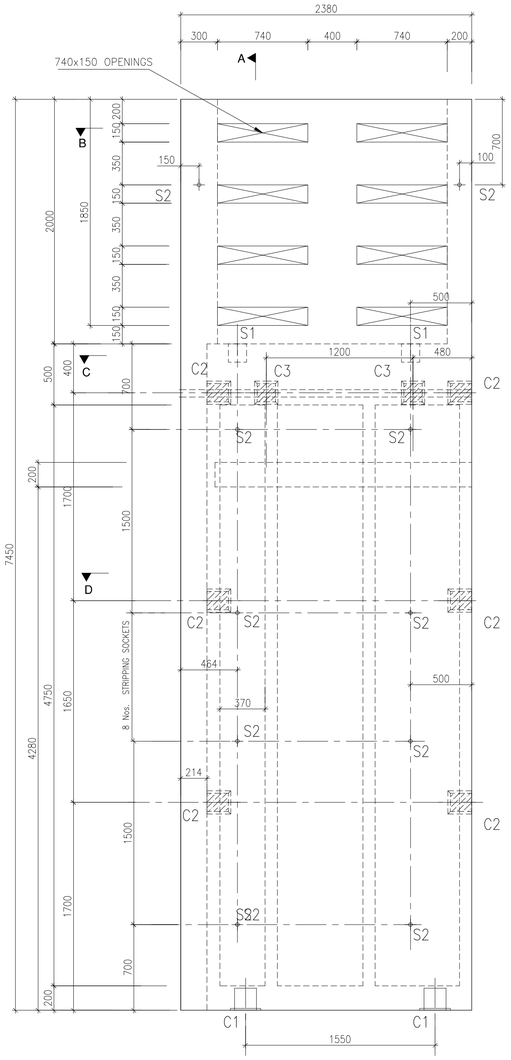
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED 02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

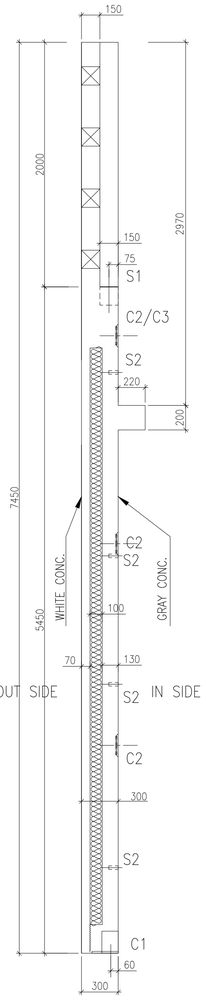
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067

DRAWING NO. RA140-32-BUI-CW-DW-65676-6
REV. C1

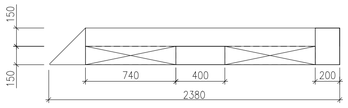
A0(841X1197mm +2mm)



ELEVATION

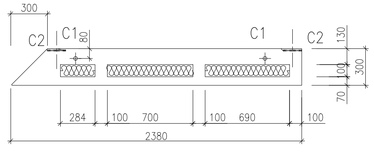


SECTION-A



SECTION-B

SECTION-C



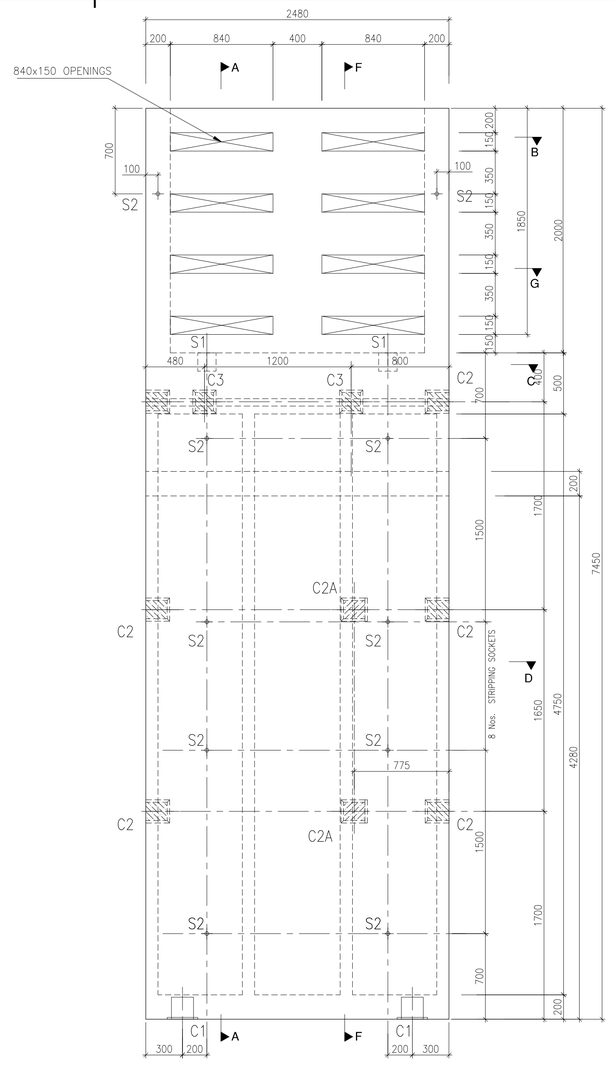
SECTION-D

WALL- W2A

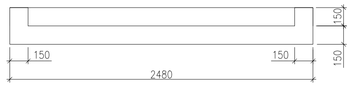
Nos. REQD. = 1 VOLUME 3.60 m³

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C3- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

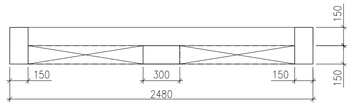
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001



ELEVATION

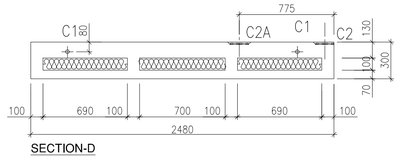


SECTION-G



SECTION-B

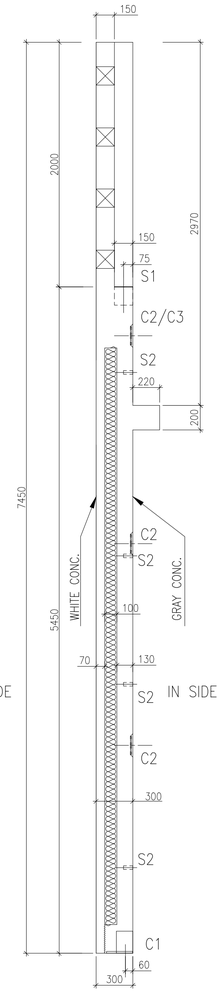
SECTION-C



SECTION-D

WALL- W4

Nos. REQD. = 1 VOLUME 4.62 m³



SECTION A-A

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C2A-2 No CONNECTION
C3- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

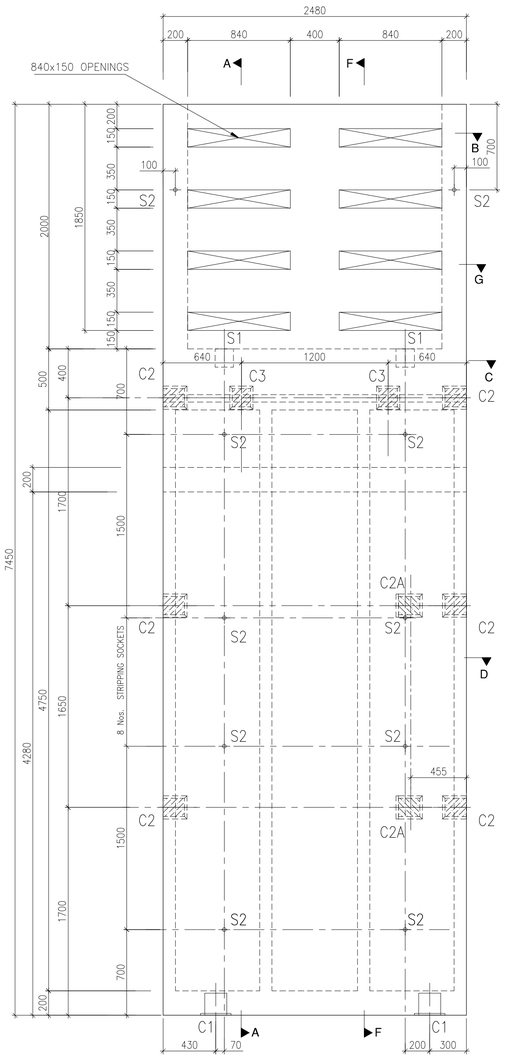
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL:23260054, FAX :23260067.

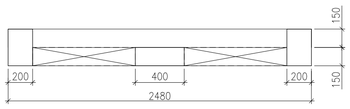
DRAWING NO.
RA140-32-BUI-CW-DW-65676-7

REV.
C1

A0(841X1197mm +2mm)

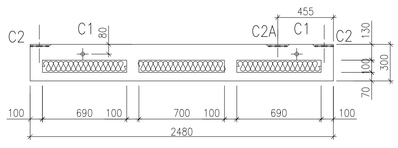


ELEVATION



SECTION-B

SECTION-C



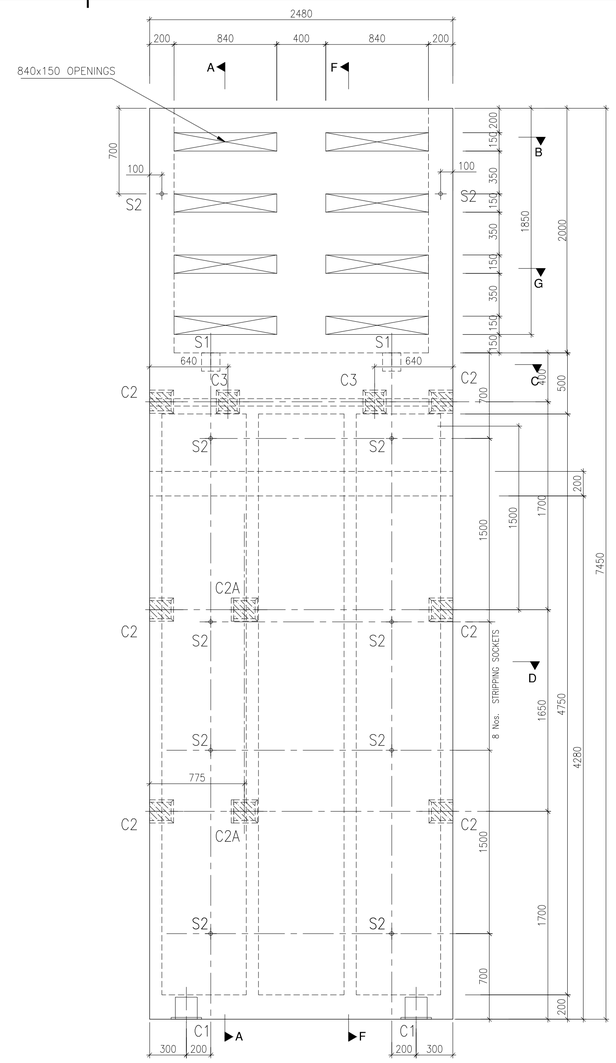
SECTION-D

WALL- W6A

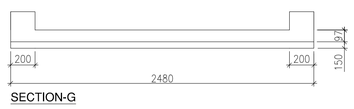
Nos. REQD. = 1 VOLUME 4.62 m³

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C2A-2 No CONNECTION
C3- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

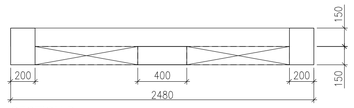
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001



ELEVATION

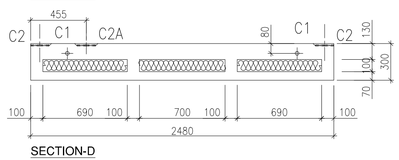


SECTION-G



SECTION-B

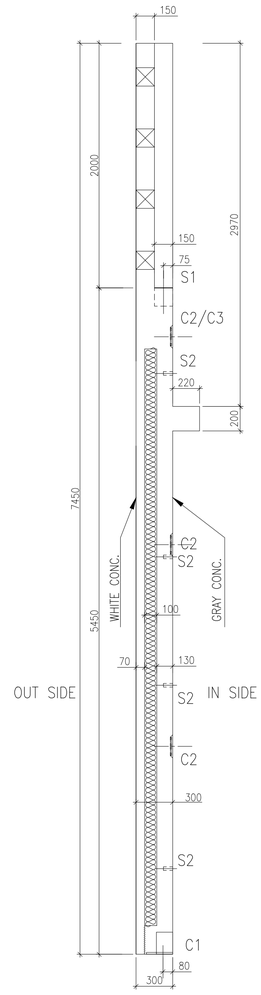
SECTION-C



SECTION-D

WALL- W6

Nos. REQD. = 1 VOLUME 4.62 m³



SECTION A-A

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C2A-2 No CONNECTION
C3- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

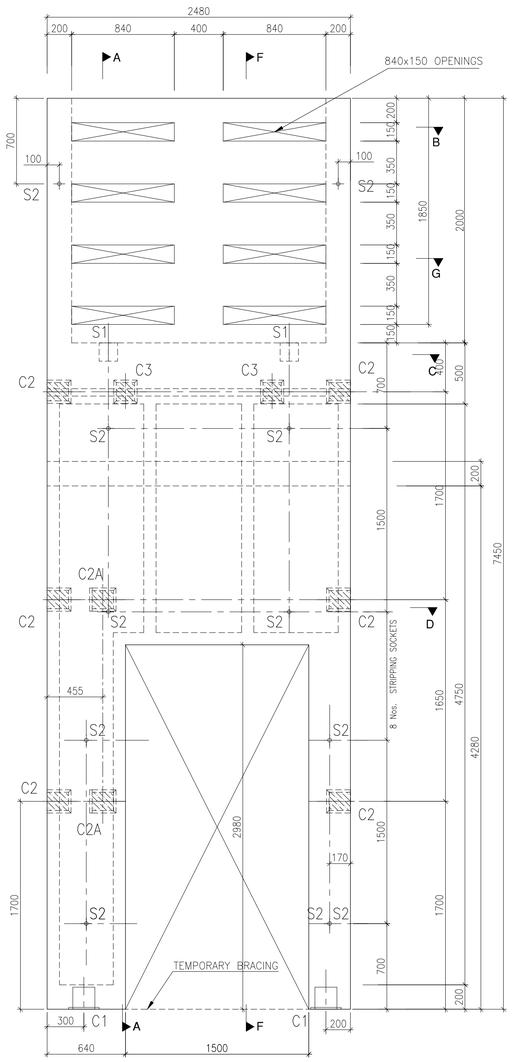
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

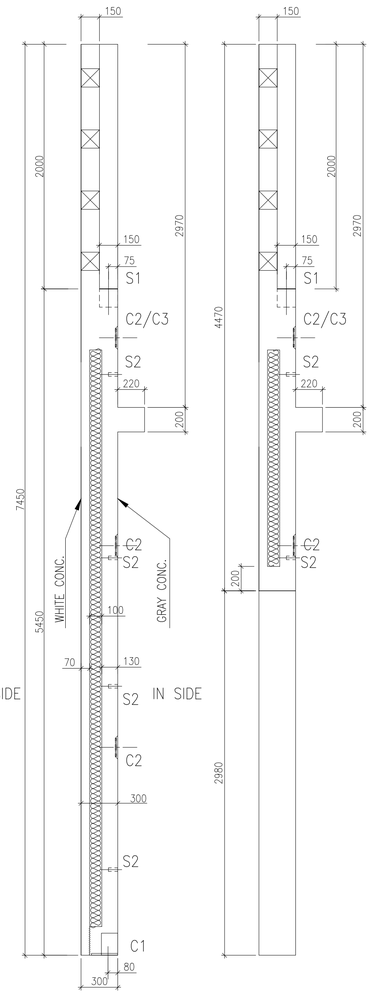
DRAWING NO.
RA140-32-BUI-CW-DW-65676-8

REV.
C1

A0(841X1197mm +2mm)



ELEVATION

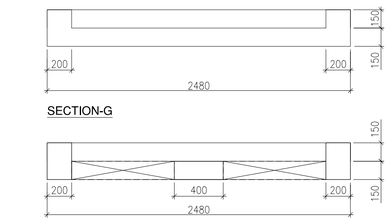


SECTION A-A

SECTION-F

OUT SIDE

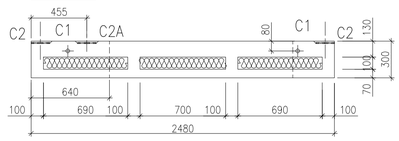
IN SIDE



SECTION-G

SECTION-B

SECTION-C



SECTION-D

WALL- W11H

Nos. REQD. = 1

VOLUME 3.28 m³

C1- 2 No CONNECTION

C2- 6 No CONNECTION

C2A-2 No CONNECTION

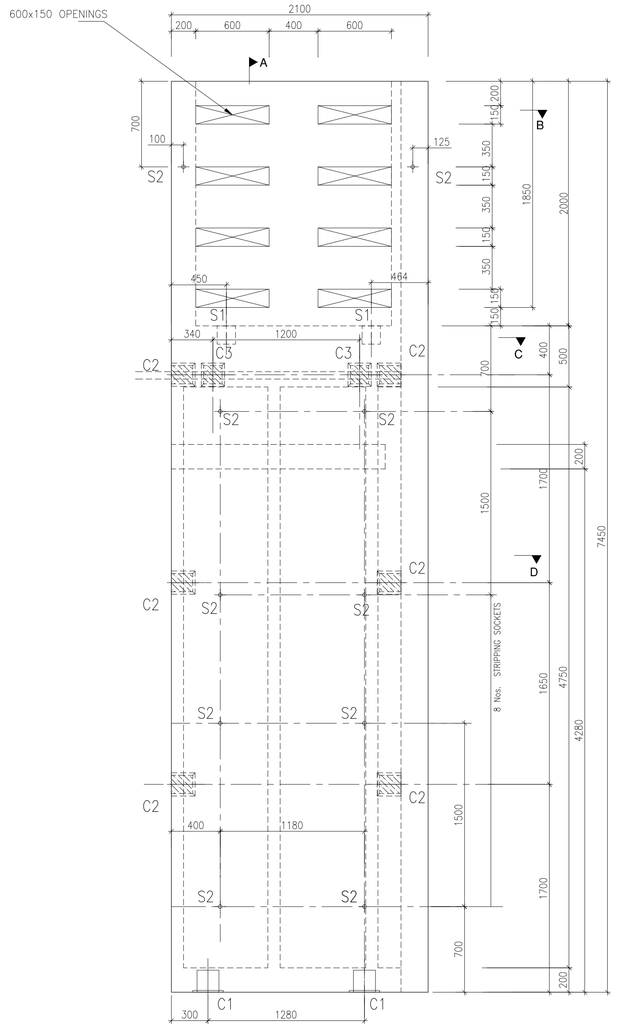
C3- 2 No CONNECTION

S1- 2 No LIFTING HOOKS IN RECESS

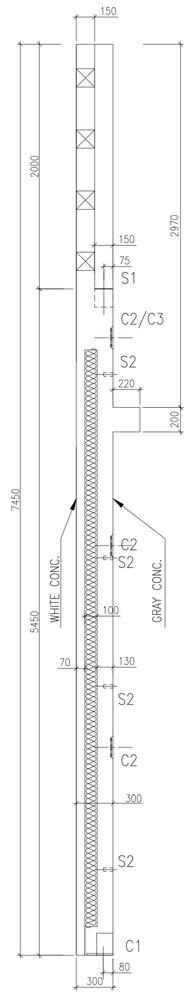
S2- 10 No STRIPPING SOCKETS

NOTE

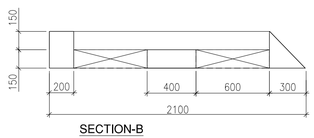
FOR REINFORCEMENT DETAILS REFER DWG.No. STUW-001



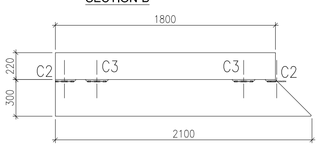
ELEVATION



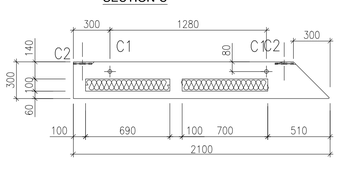
SECTION A-A



SECTION-B



SECTION-C



SECTION-D

WALL- W10A

Nos. REQD. = 1

VOLUME 3.52 m³

C1- 2 No CONNECTION

C2- 5 No CONNECTION

C3- 2 No CONNECTION

S1- 2 No LIFTING HOOKS IN RECESS

S2- 10 No STRIPPING SOCKETS

NOTE

FOR REINFORCEMENT DETAILS REFER DWG.No. STUW-001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH

WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH

AT 28 DAYS = 350 kg/cm²

STRIPPING = 200 kg/cm²

REINFORCING STEEL

AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER

50 mm FOR FOOTINGS

25 mm FOR COLUMN NECK

30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE NORTH ISLAND SUBSTATION BSS 1 WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

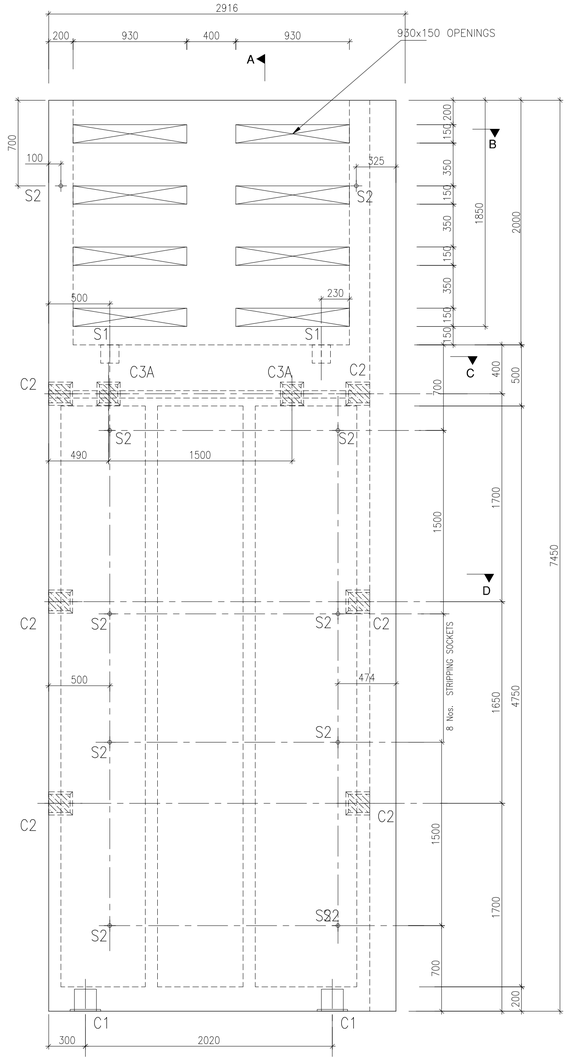
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067

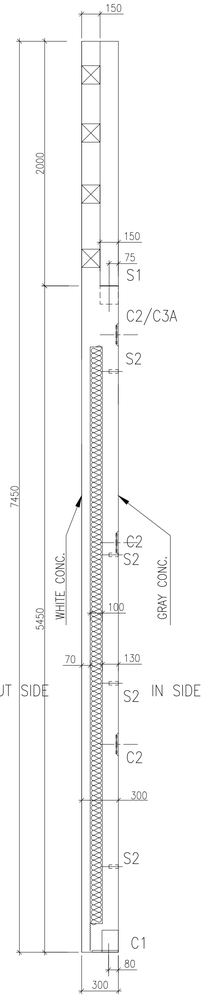
DRAWING NO. RA140-32-BUI-CW-DW-65676-9

REV. C1

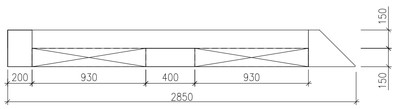
A0(841X1197mm +2mm)



ELEVATION

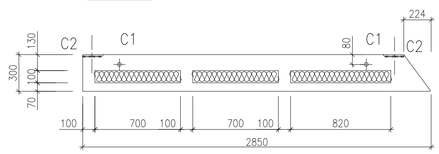


SECTION-A



SECTION-B

SECTION-C



SECTION-D

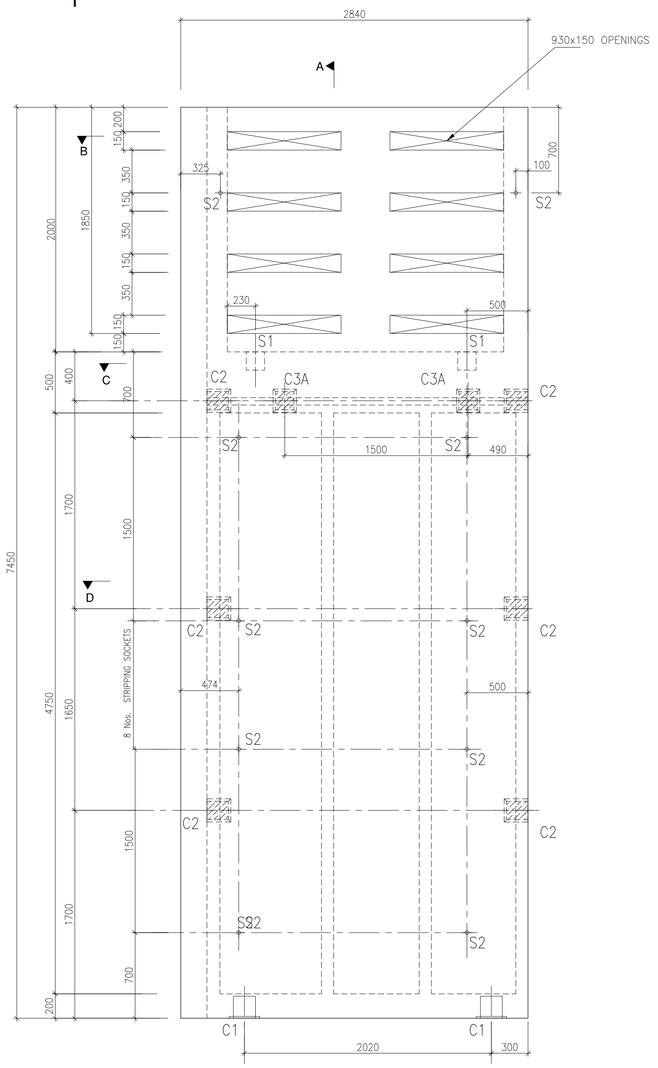
WALL- W12

Nos. REQD. = 2 VOLUME 4.20 m³

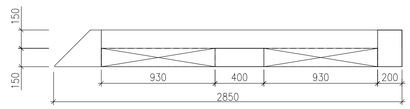
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION

S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

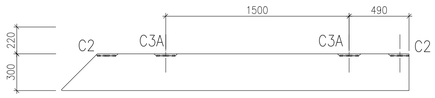
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



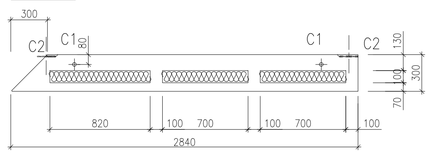
ELEVATION



SECTION-B



SECTION-C



SECTION-D

WALL- W12H

Nos. REQD. = 2 VOLUME 4.20 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION

S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

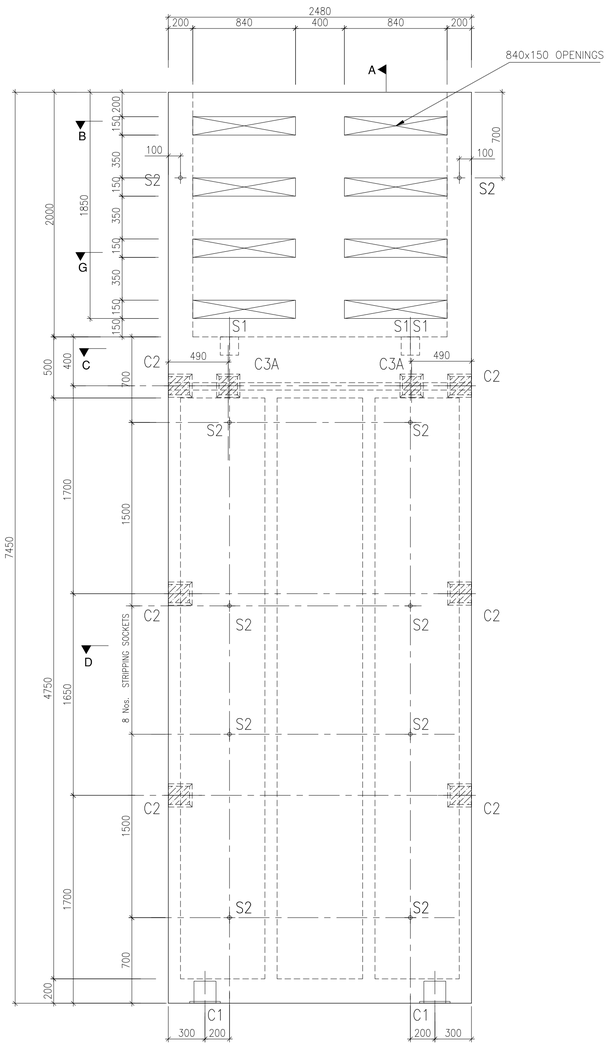
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

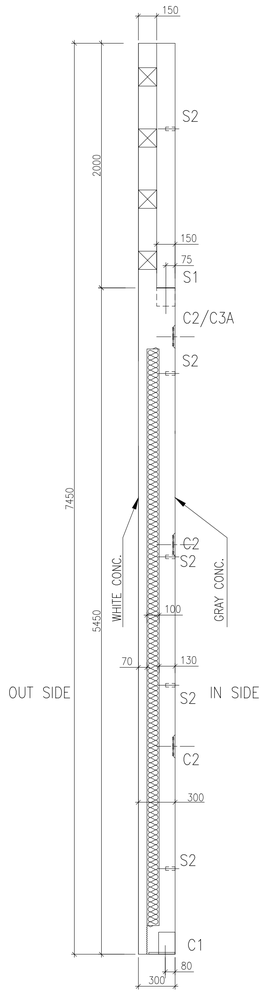
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65676-10
REV. C1

A0(841x1189mm +2mm)

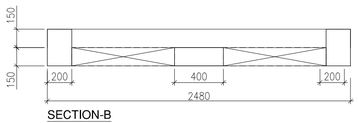


ELEVATION

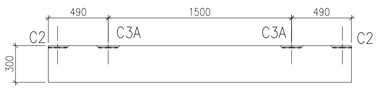


SECTION-A

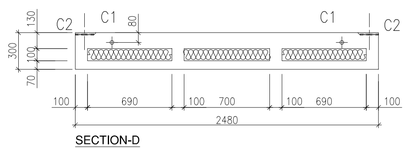
SECTION-G



SECTION-B



SECTION-C

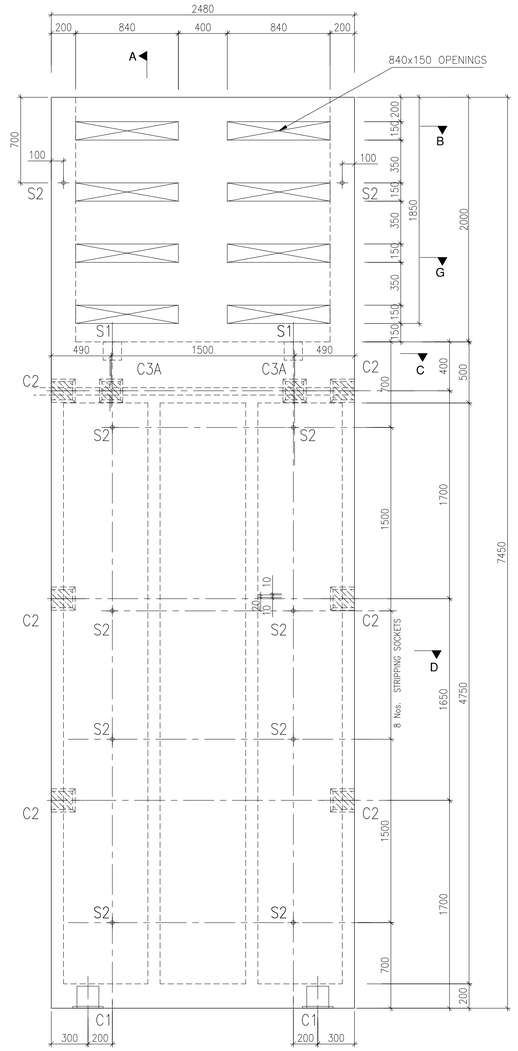


SECTION-D

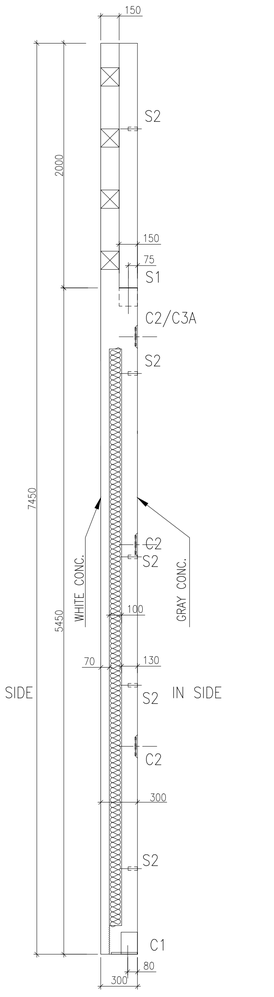
C1- 2 No CONNECTION
C2- 6 No CONNECTION
C3A- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001

WALL- W13
Nos. REQD. = 2 VOLUME 4.62 m³

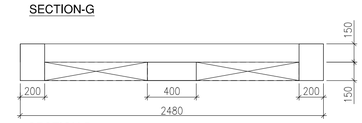


ELEVATION



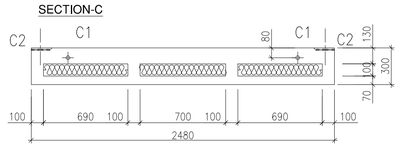
SECTION-A

SECTION-G



SECTION-B

SECTION-C



SECTION-D

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C3A- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW-001

WALL- W13H
Nos. REQD. = 1 VOLUME 4.62 m³

NOTES

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SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
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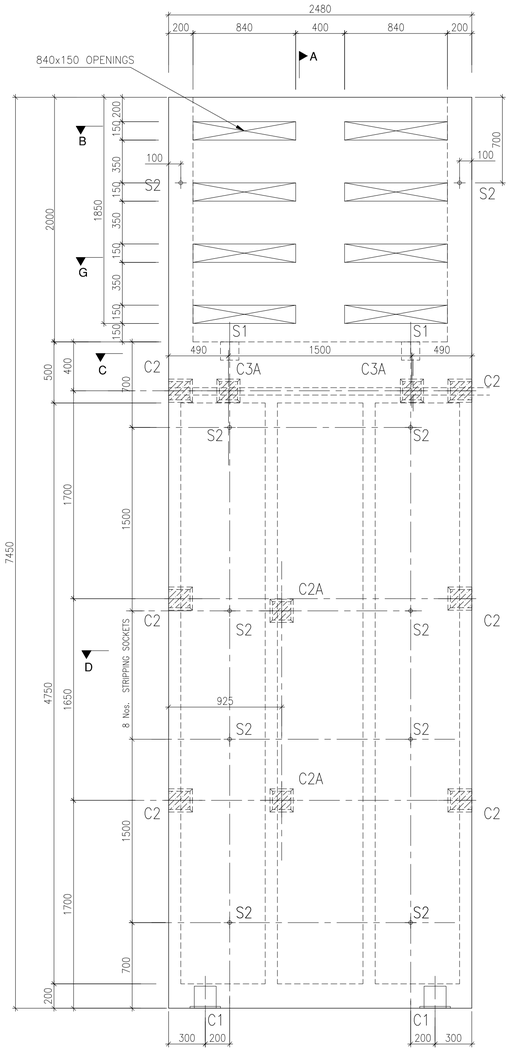
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX :23260067.

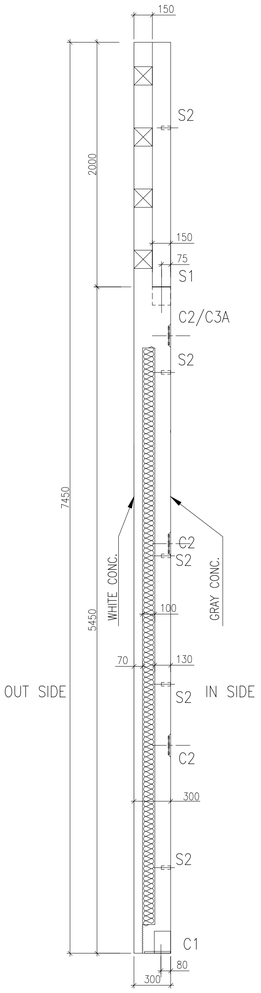
DRAWING NO.
RA140-32-BUI-CW-DW-65676-11

REV.
C1

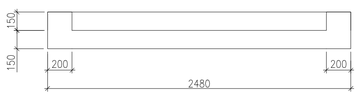
A0(841X1189mm +2mm)



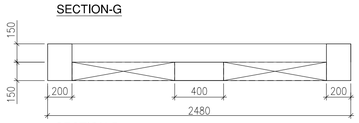
ELEVATION



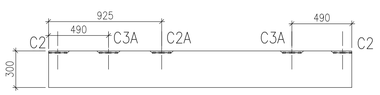
SECTION-A



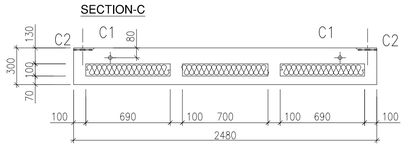
SECTION-G



SECTION-B



SECTION-C



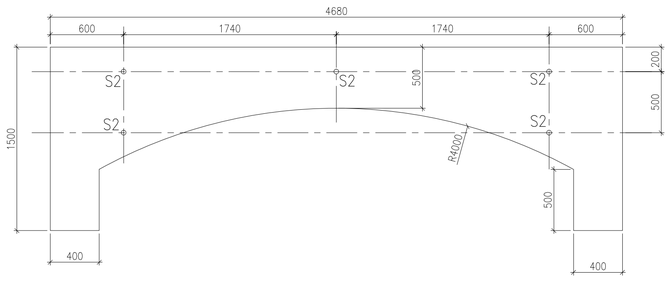
SECTION-D

WALL- W13AH

Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A– 2 No CONNECTION
C3A– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

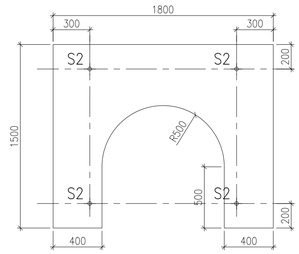
NOTE
FOR REINFORCEMENT DETAILS REFER DWG.No. STUW–001



ELEVATIION

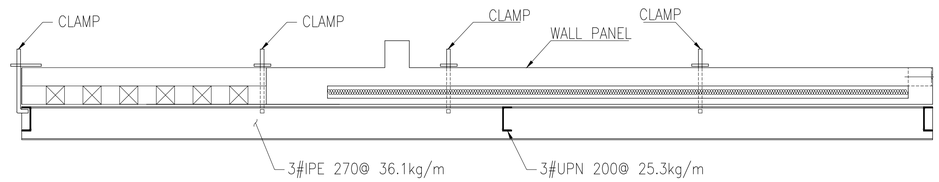
ARCH UNIT - P1

SECTION-D

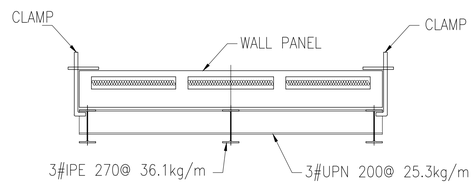


ELEVATIION

ARCH UNIT - P2



LONGITUDINAL SECTION



CROSS- SECTION

STEEL FRAME FOR TILTING WALL UNITS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

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STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

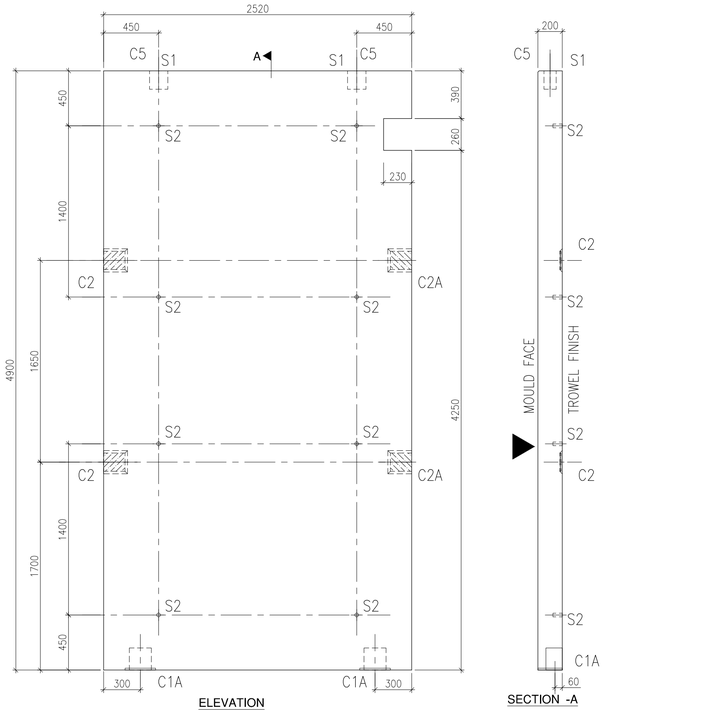
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17
02.07.17				

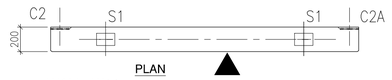
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.23260054, FAX 23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65676-12
REV. C1

A0(841x1189mm +2mm)

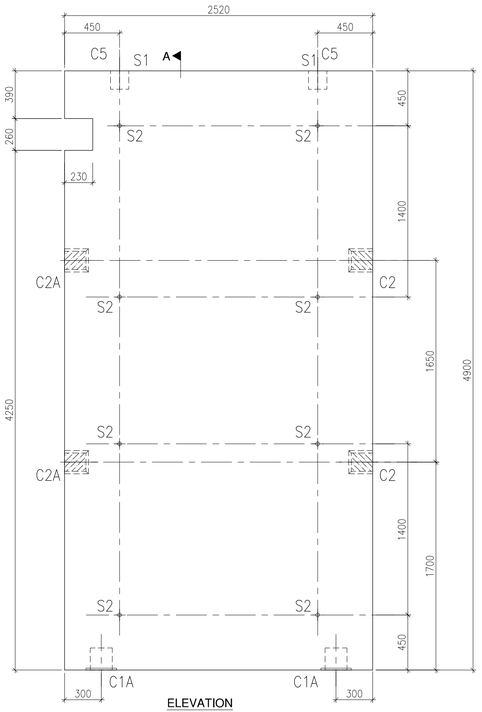


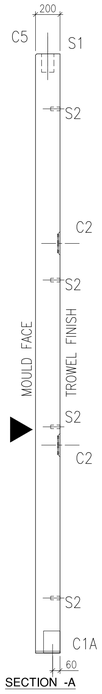


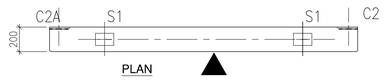
WALL- W14

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS



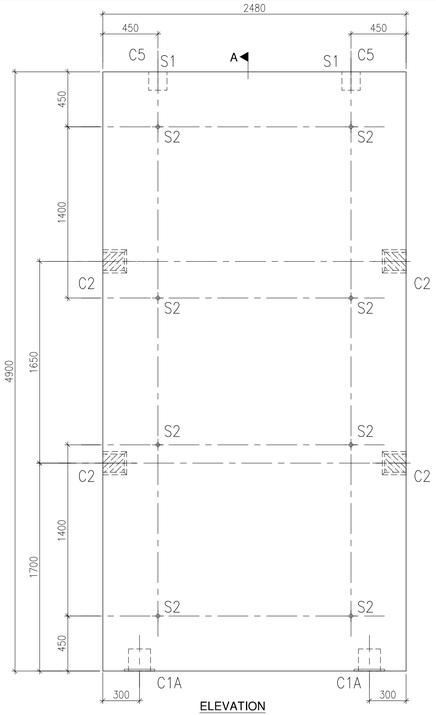


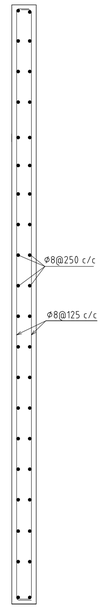


WALL- W14H

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS





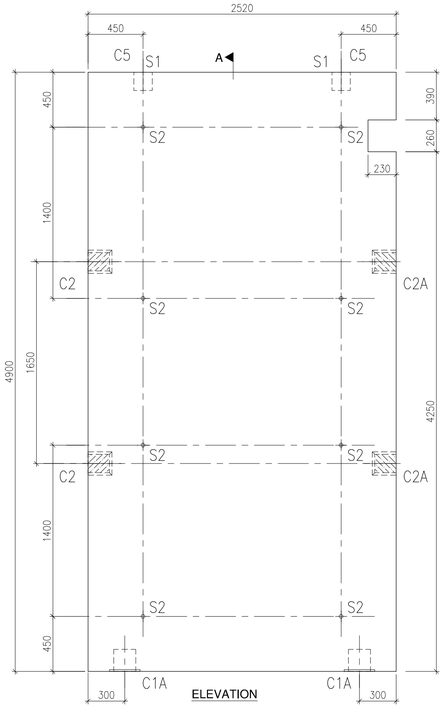
SECTION–A
(REINFORCEMENT DET. TYP)

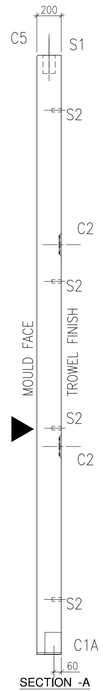
WALL- W15 Nos. REQD. = 2

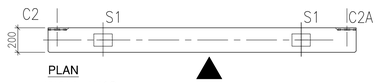
WALL- W17 Nos. REQD. = 3

VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS



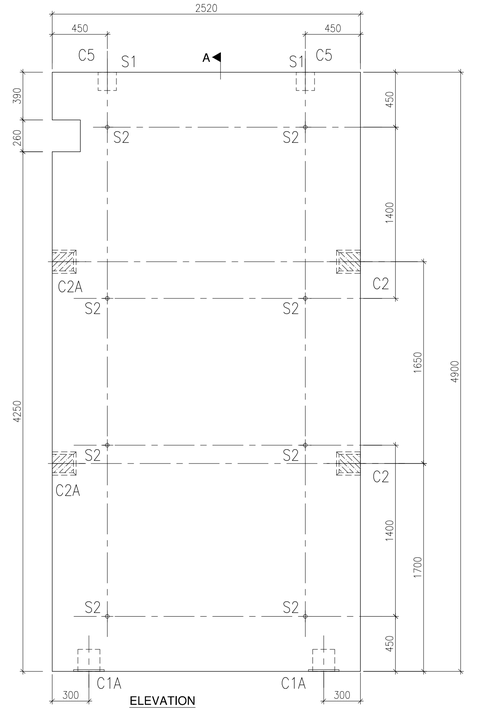




WALL- W16

Nos. REQD. = 2 VOLUME 2.43 m³

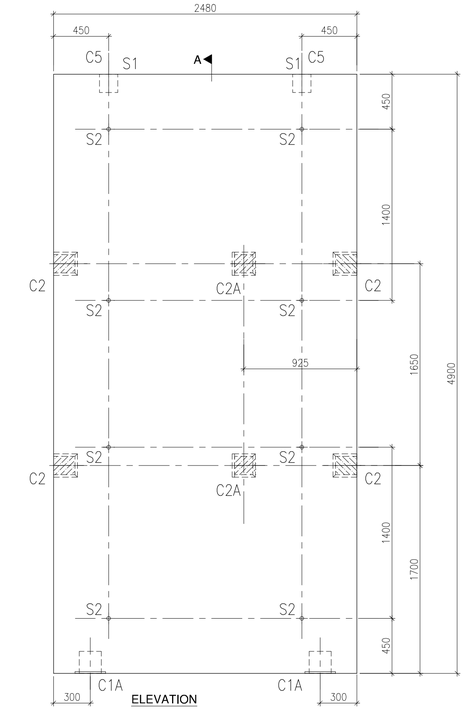
C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS

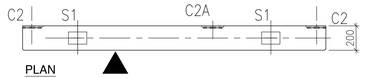


WALL- W16H

Nos. REQD. = 2 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS





WALL- W17AH

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 4 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

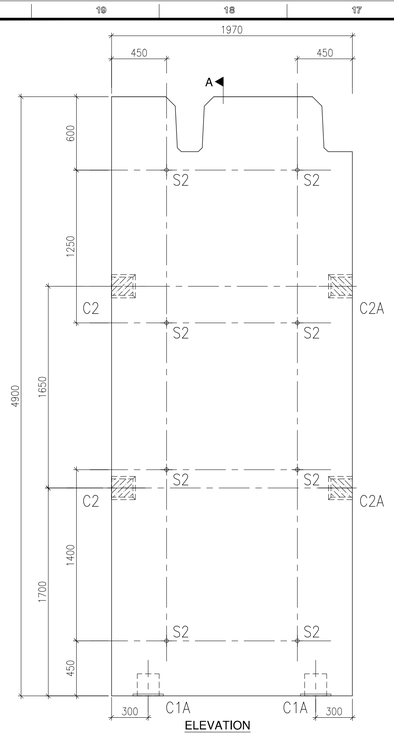
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED 02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX 23260067.

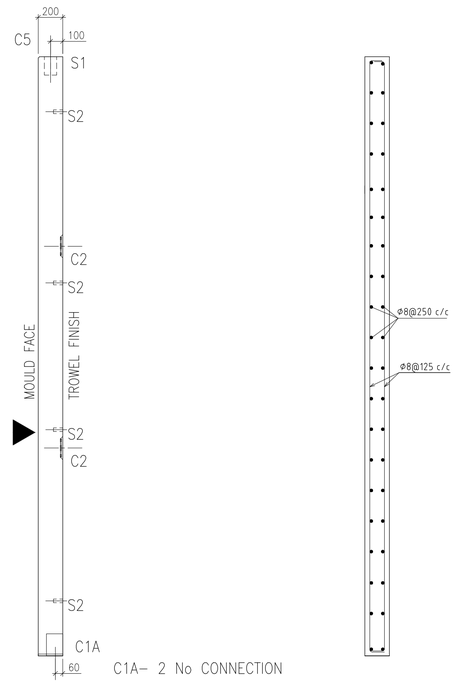
DRAWING NO. RA140-32-BUI-CW-DW-65676-13
REV. C1

A0(841X1189mm +2mm)



WALL- W18A

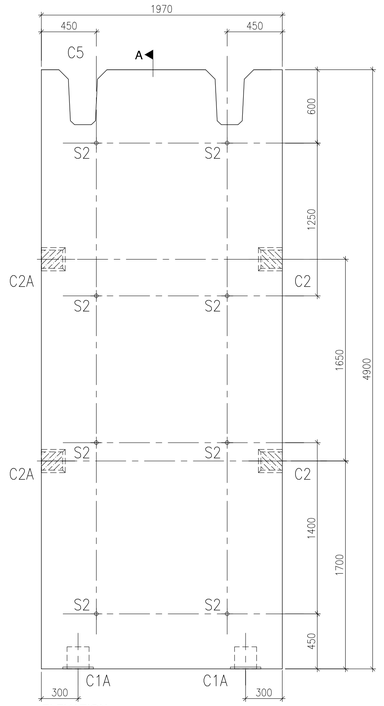
Nos. REQD. = 1 VOLUME 1.93 m³



SECTION -A

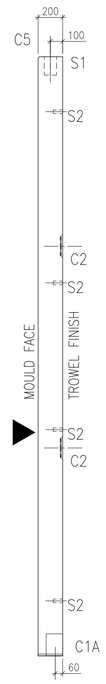
C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

SECTION–A
(REINFORCEMENT DET. TYP)



WALL- W18AH

Nos. REQD. = 1 VOLUME 1.93 m³



SECTION -A

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

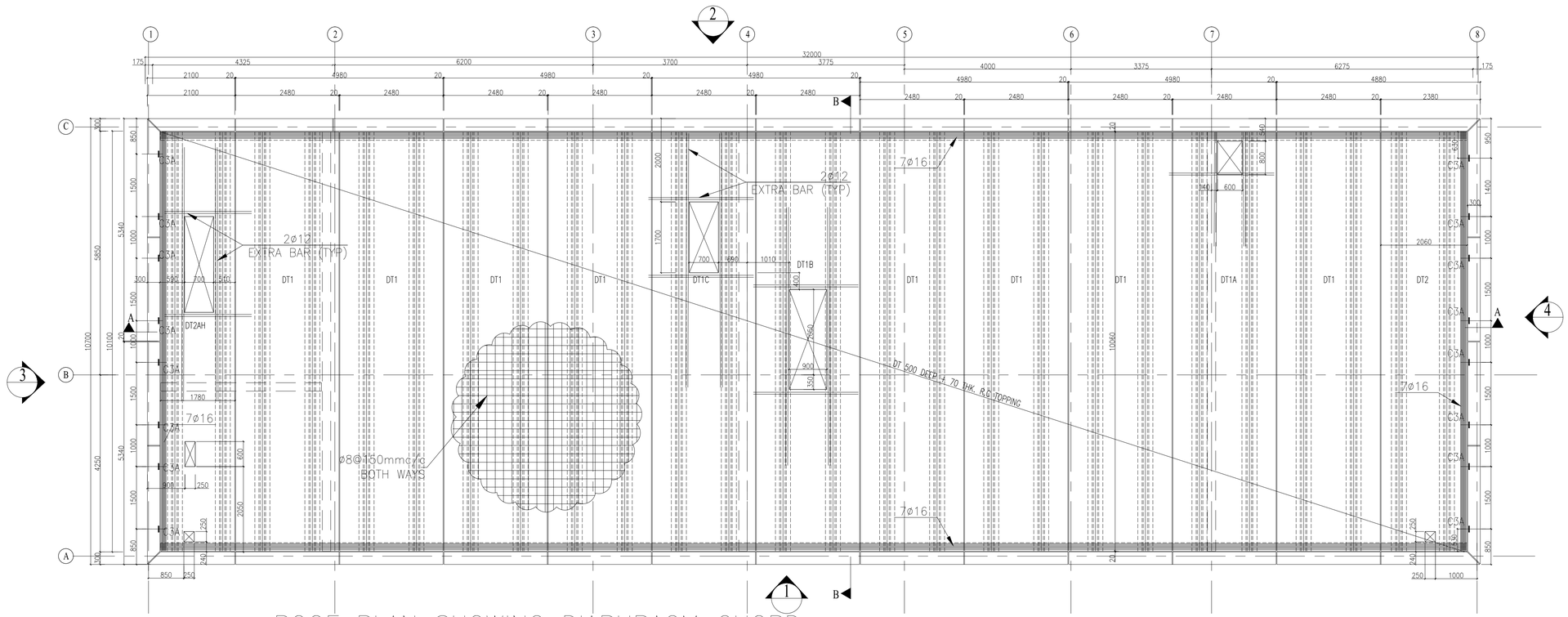
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

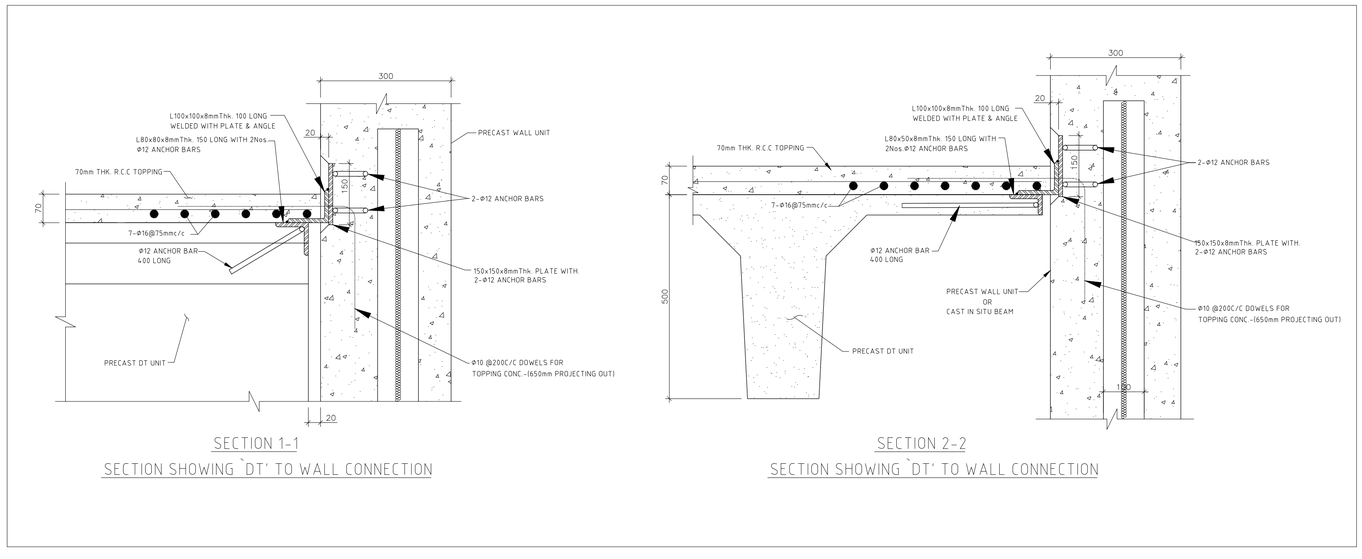
DRAWING NO. RA140-32-BUI-CW-DW-65676-14

REV. C1

A0(841X1189mm +2mm)



ROOF PLAN SHOWING DIAPHRAGM CHORD REINFORCEMENT IN STRUCTURAL TOPPING CONCRETE



SECTION 1-1
SECTION SHOWING `DT' TO WALL CONNECTION

SECTION 2-2
SECTION SHOWING `DT' TO WALL CONNECTION

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ROOF PLAN (R/F . IN STRUCTURAL TOPPING CONCRETE)

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65677

REV. C1

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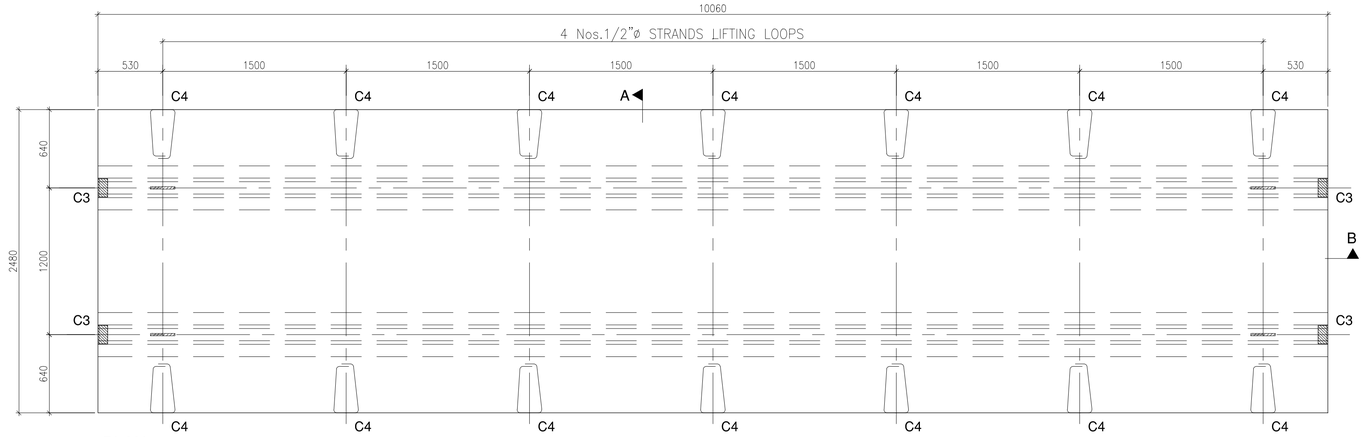
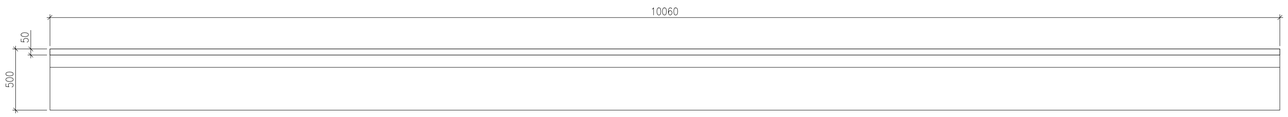


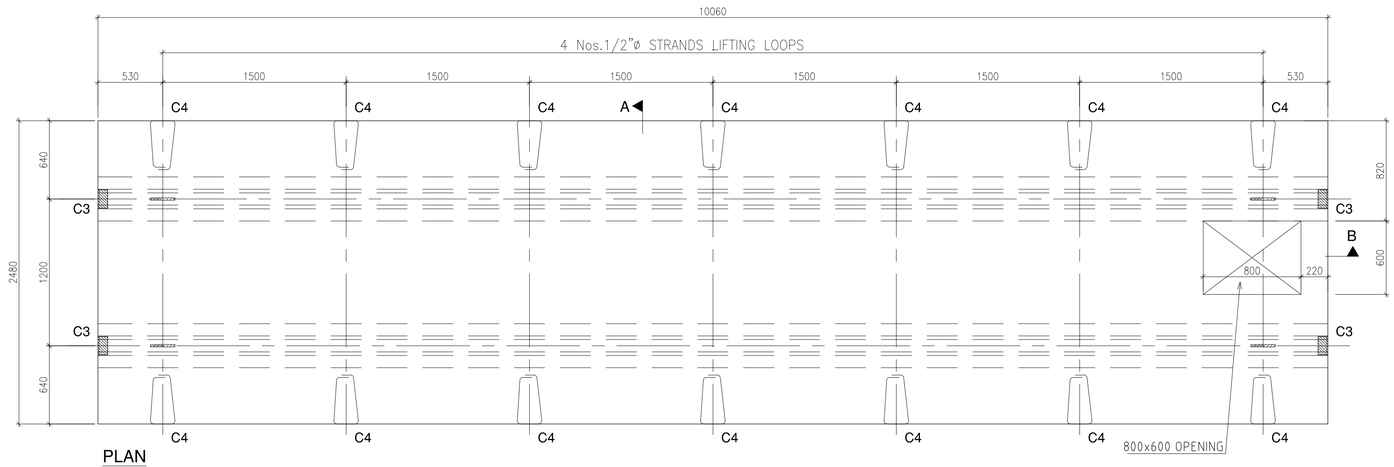
PLAN



SECTION - B

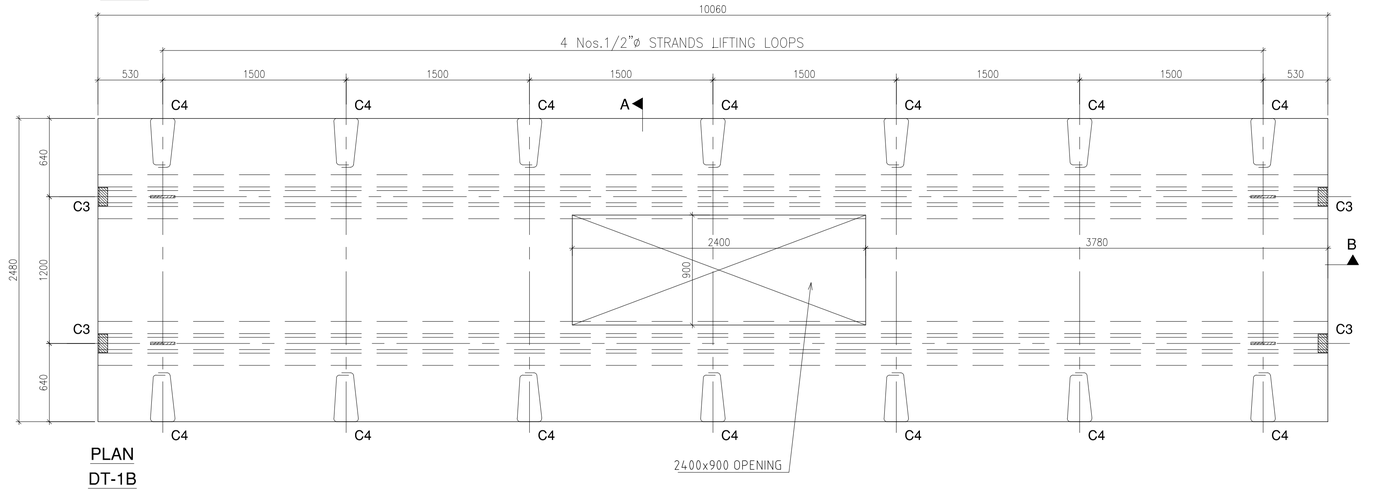
DT-1

Nos. REQD. = 8



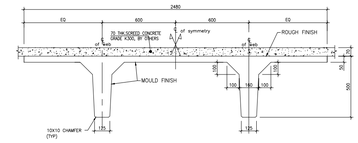
PLAN

DT-1A



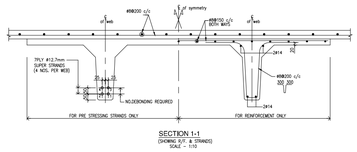
PLAN

DT-1B



SECTION - A

(SHOWING DIMENSIONS)



SECTION 1-1

(SHOWING B/T & STRANDS)

SCALE - 1:10

PRECAST CONCRETE `DT500' STANDARD

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CLEAR COVER TO REINFORCEMENT = 20mm (MINIMUM).
3. LAP LENGTH OF REINFORCING BAR IS 65 TIMES DIA. OF LESSER DIAMETER OF BAR.
4. CUBE STRENGTH OF CONCRETE AT 28 DAYS = 50N/mm² FOR PRECAST PRESTESSED 'DT' UNITS.
5. CYLINDER STRENGTH OF CONCRETE AT TRANSFER OF PRESTRESS =35 N/mm² (INTERNAL DATA FOR PRECAST PLANT)
6. STRUCTURAL INSITU CONCRETE SCREED 70mm THICK MINIMUM AND 28 DAYS STRENGTH = 35N/mm².
7. STRANDS 12.7mm DIA. TO ASTM A 416/74.
8. HIGH YIELD STRENGTH DEFORMED BAR fy NOT LESS THAN 420MPa (INDICATED THUS #) TO ASTM A615 STANDARD
9. CEMENT TYPE – 1 (OPC).
10. JACKING FORCE PER STRAND =134.0KN.
11. ULTIMATE BREAKING LOAD PER STRAND = 186 KN.
12. FACTOY FINISH = EX-MOULD FINISH AND AS SHOWN.
13. ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL (ASTM A36 RED OXIDE PAINTED).

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
DT UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

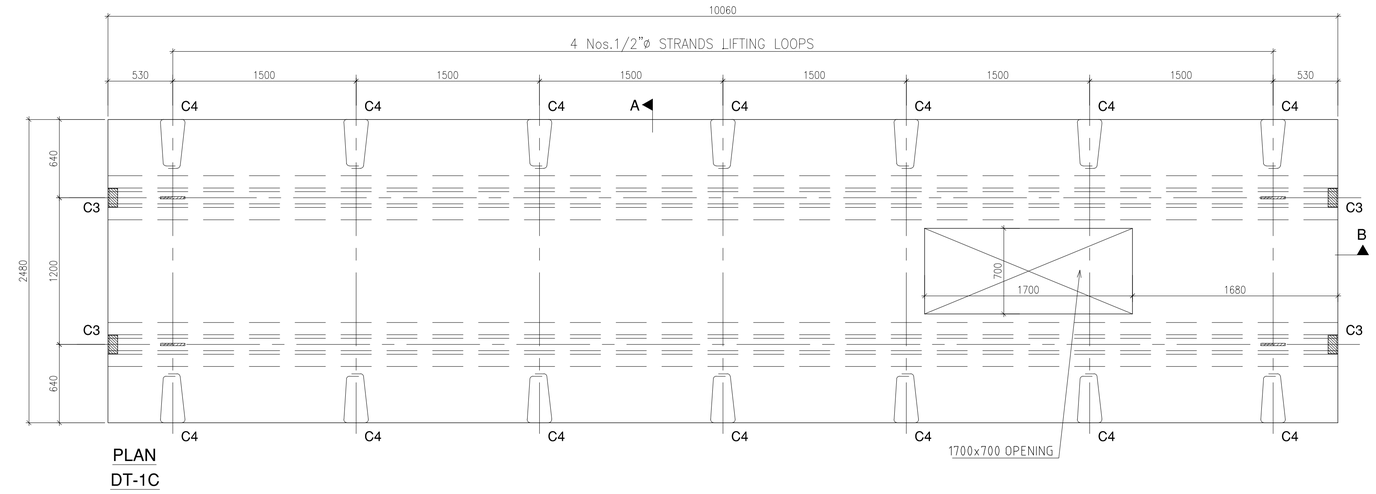
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

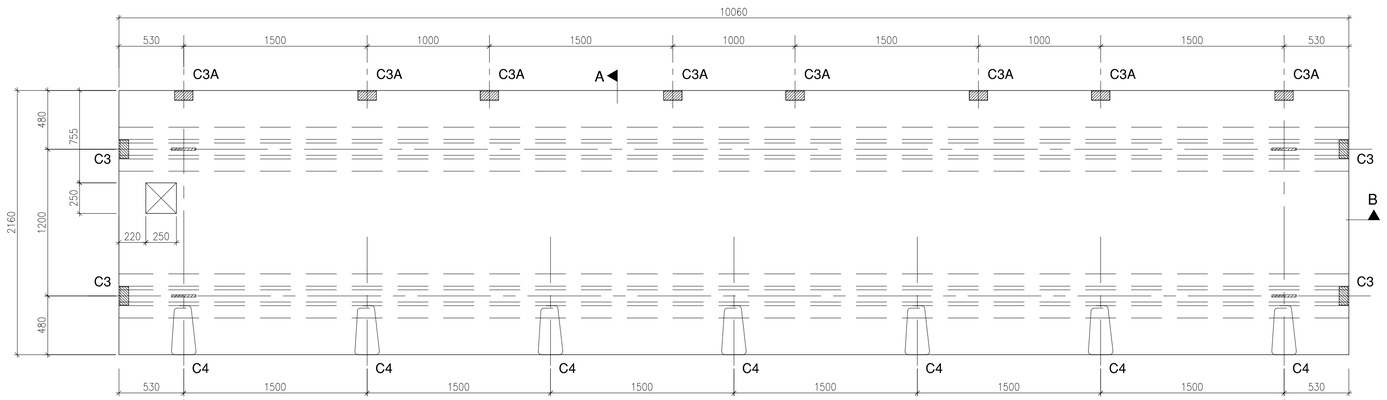
DRAWING NO. RA140-32-BUI-CW-DW-65678-1

REV. C1

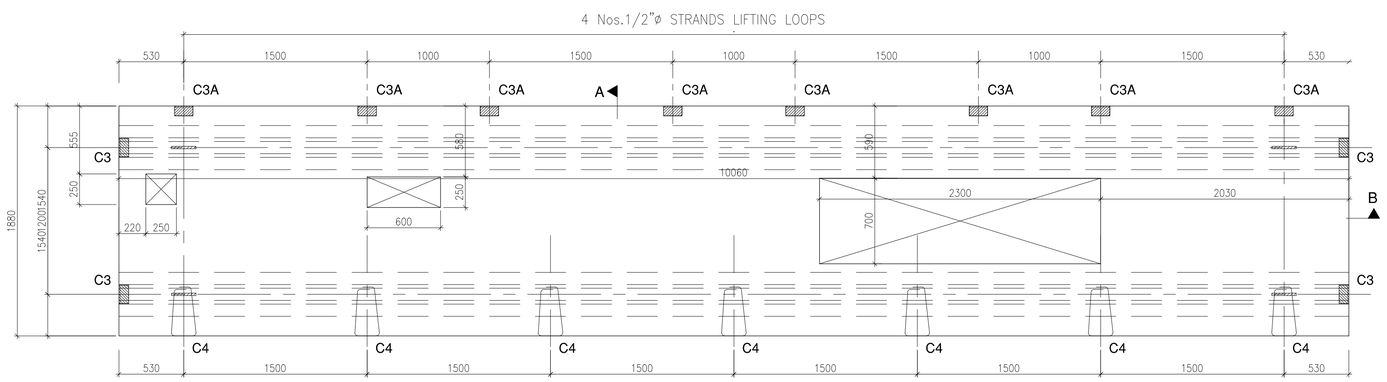
A0(841X1189mm +2mm)



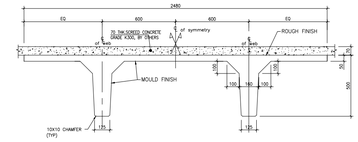
PLAN
DT-1C



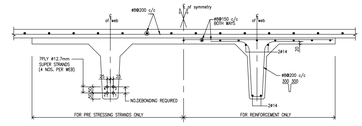
PLAN
DT-2



DT-2AH
PLAN



SECTION - A
(SHOWING DIMENSIONS)



SECTION 1-1
(SHOWING S/T & STRANDS)
SCALE - 1:10

PRECAST CONCRETE `DT500' STANDARD

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CLEAR COVER TO REINFORCEMENT = 20mm (MINIMUM).
3. LAP LENGTH OF REINFORCING BAR IS 65 TIMES DIA. OF LESSER DIAMETER OF BAR.
4. CUBE STRENGTH OF CONCRETE AT 28 DAYS = 50N/mm² FOR PRECAST PRESTESSED 'DT' UNITS.
5. CYLINDER STRENGTH OF CONCRETE AT TRANSFER OF PRESTRESS =35 N/mm² (INTERNAL DATA FOR PRECAST PLANT)
6. STRUCTURAL INSITU CONCRETE SCREED 70mm THICK MINIMUM AND 28 DAYS STRENGTH = 35N/mm².
7. STRANDS 12.7mm DIA. TO ASTM A 416/74.
8. HIGH YIELD STRENGTH DEFORMED BAR fy NOT LESS THAN 420MPa (INDICATED THUS #) TO ASTM A615 STANDARD
9. CEMENT TYPE – 1 (OPC).
10. JACKING FORCE PER STRAND =134.0KN.
11. ULTIMATE BREAKING LOAD PER STRAND = 186 KN.
12. FACTOY FINISH = EX-MOULD FINISH AND AS SHOWN.
13. ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL (ASTM A36 RED OXIDE PAINTED).

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
DT UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

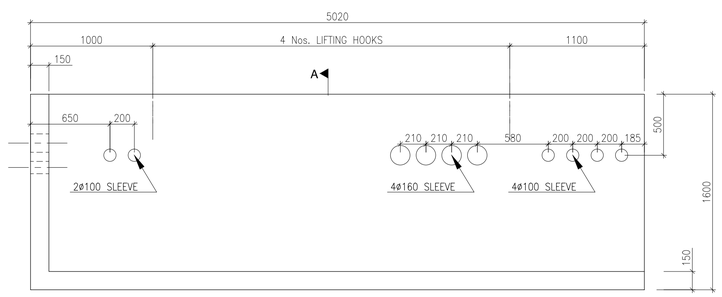
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.23260054, FAX .23260067.

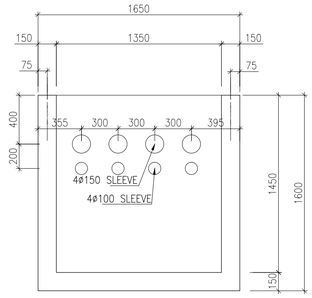
DRAWING NO.
RA140-32-BUI-CW-DW-65678-2

REV.
C1

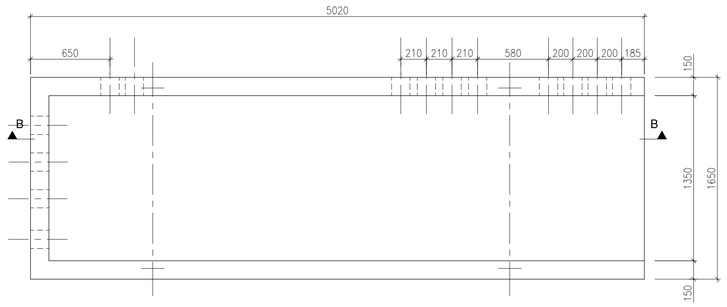
A0(841X1189mm =2m²)



SECTION B-B



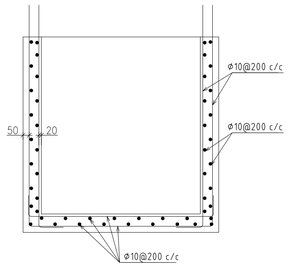
SECTION - A



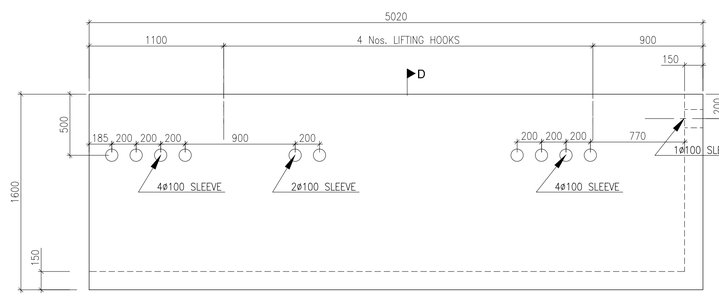
PLAN

TRENCH - TR1A

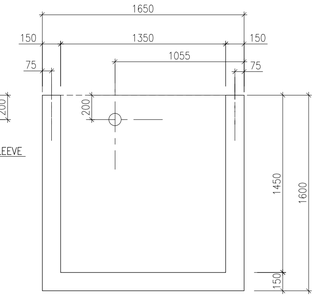
Nos. REQD. = 1



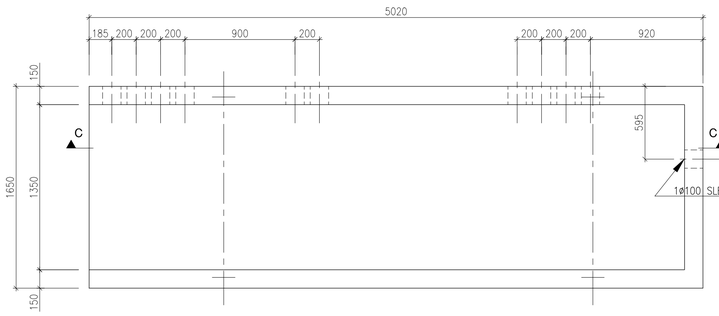
SECTION-A
SHOWING REINF.



SECTION C-C



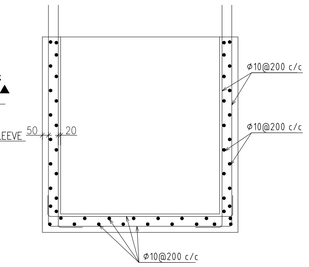
SECTION - D



PLAN

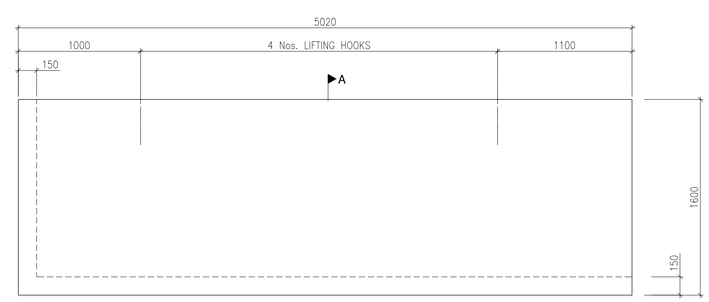
TRENCH - TR1AH

Nos. REQD. = 1

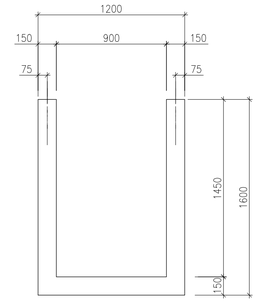


SECTION-A
SHOWING REINF.

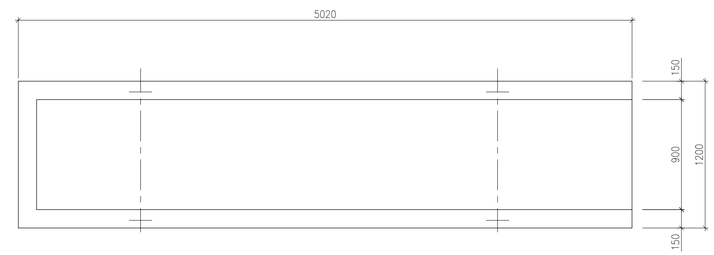
NOTES



ELEVATION



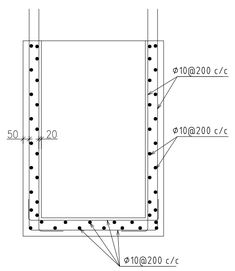
SECTION - A



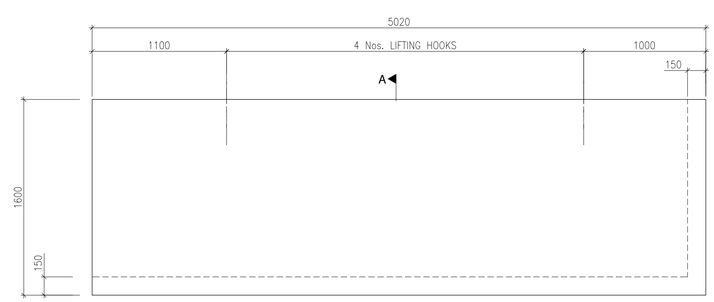
PLAN

TRENCH - TR2

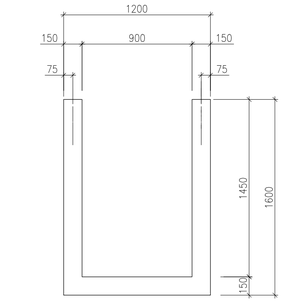
Nos. REQD. = 1



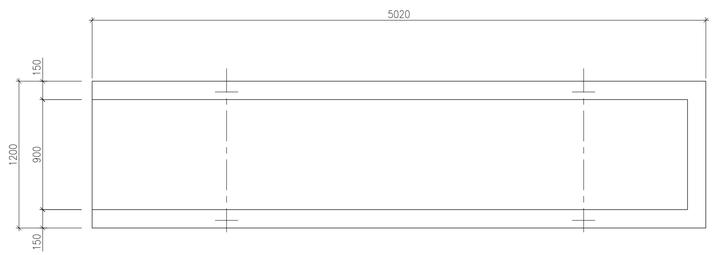
SECTION-A
SHOWING REINF.



ELEVATION



SECTION - A



PLAN

TRENCH - TR2H

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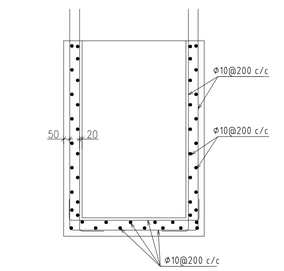


SECTION-A
SHOWING REINF.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

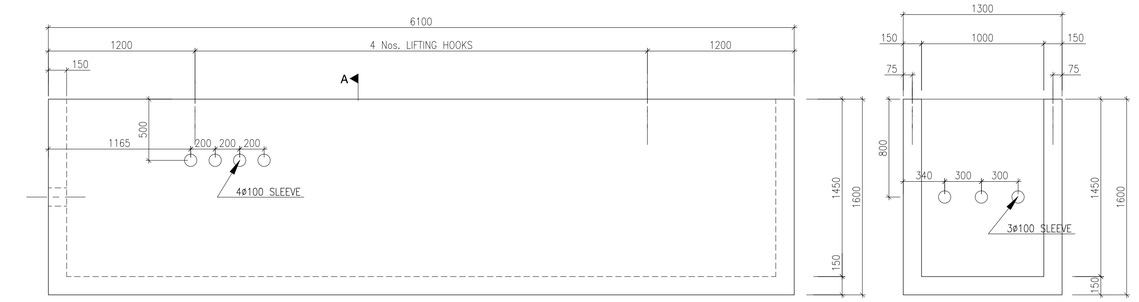
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

RA140-32-BUI-CW-DW-65679-1

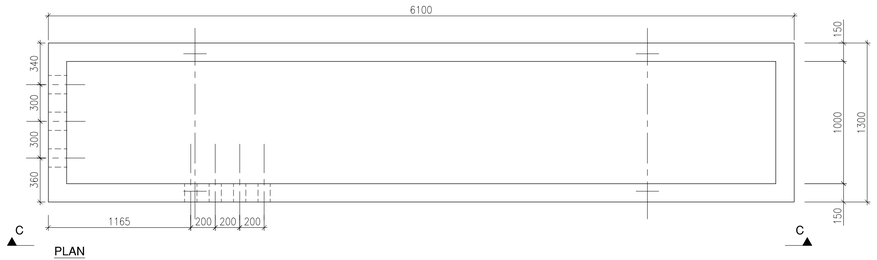
REV.

C1



ELEVATION C-C

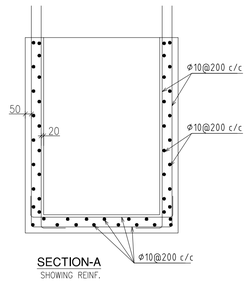
SECTION - A



PLAN

TRENCH - TR3H

Nos. REQD. = 1



SECTION-A
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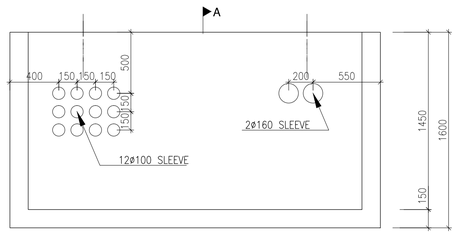

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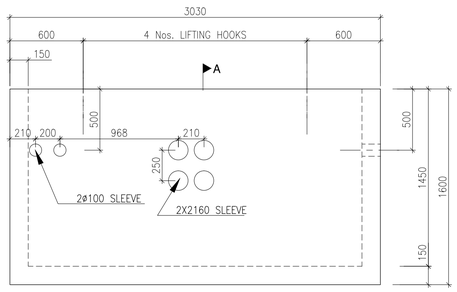
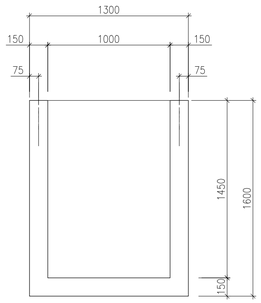
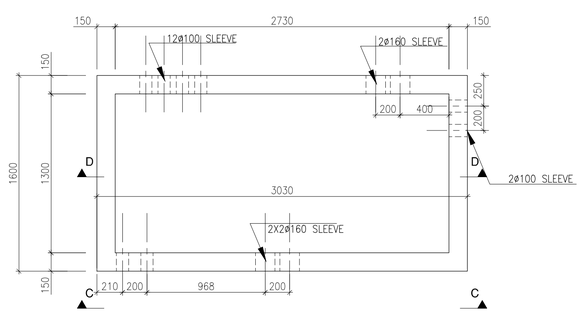


ELEVATION C-C



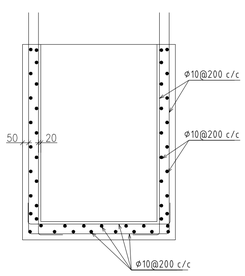
SECTION - A



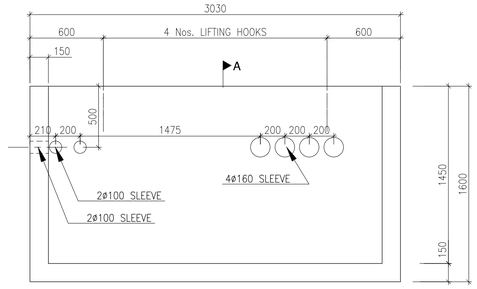
PLAN

TRENCH - TR4.2H

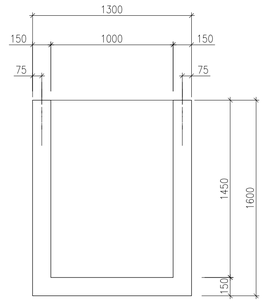
Nos. REQD. = 1



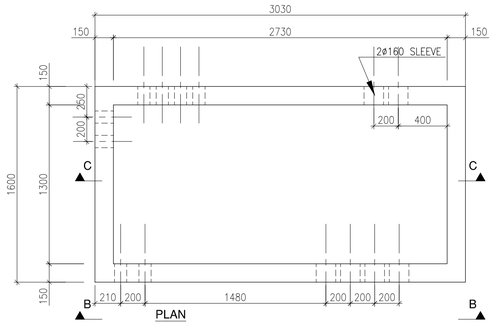
SECTION-A
SHOWING REINF.



ELEVATION B-B



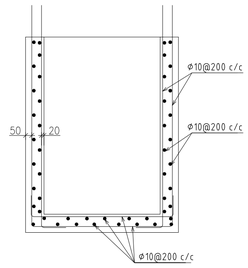
SECTION - A



PLAN

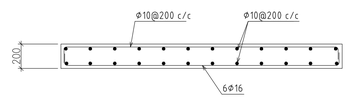
TRENCH - TR4.1H

Nos. REQD. = 1

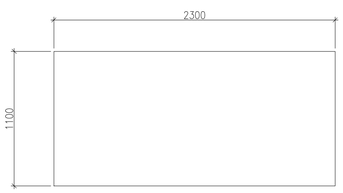


SECTION-A
SHOWING REINF.

SECTION C-C



SECTION



TRANSFORMER SUPPORT SLAB UNIT

Nos. REQD. = 4

NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

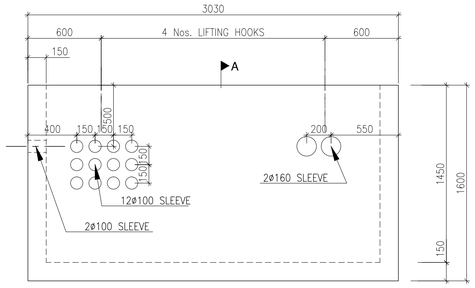
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

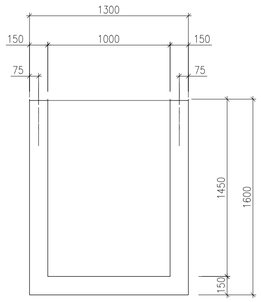
RA140-32-BUI-CW-DW-65679-2

REV.

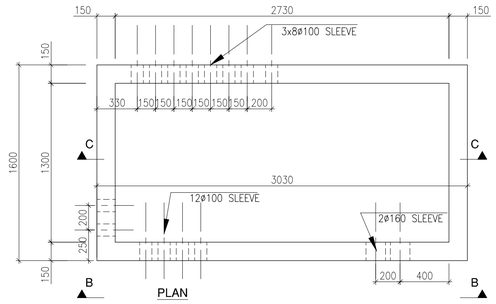
C1



ELEVATION B-B



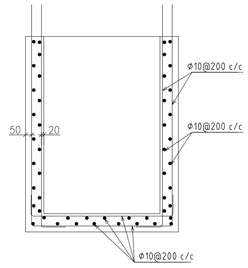
SECTION - A



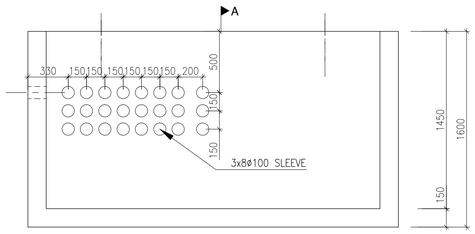
PLAN

TRENCH - TR4.3H

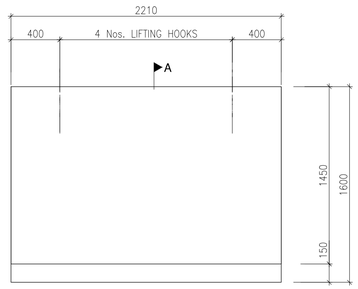
Nos. REQD. = 1



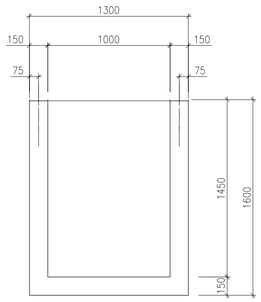
SECTION-A
SHOWING REINF.



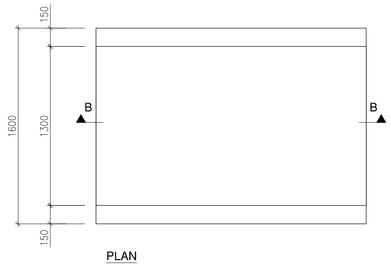
SECTION C-C



SECTION B-B



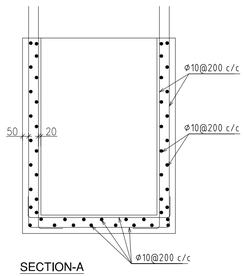
SECTION - A



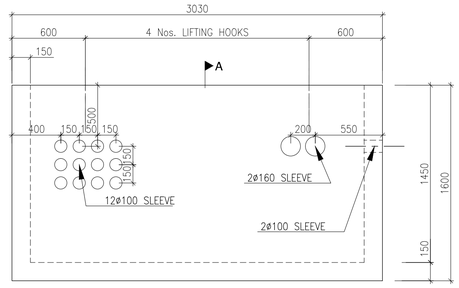
PLAN

TRENCH - TR5

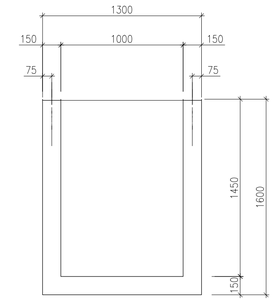
Nos. REQD. = 2



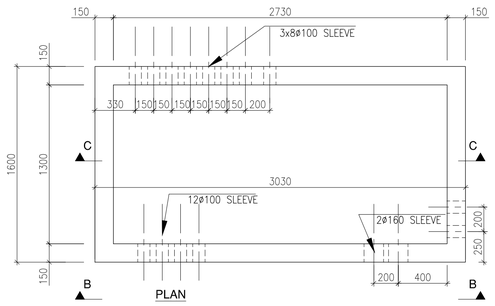
SECTION-A
SHOWING REINF.



ELEVATION B-B



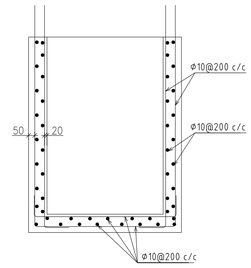
SECTION - A



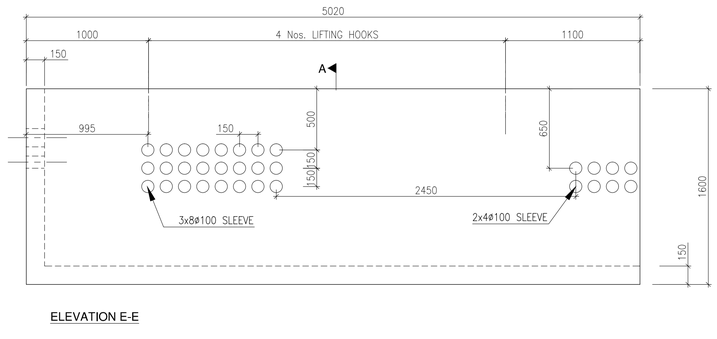
PLAN

TRENCH - TR4.4H

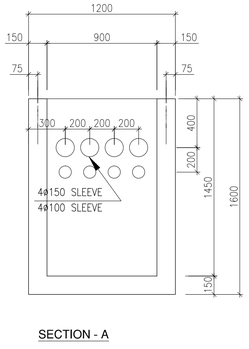
Nos. REQD. = 1



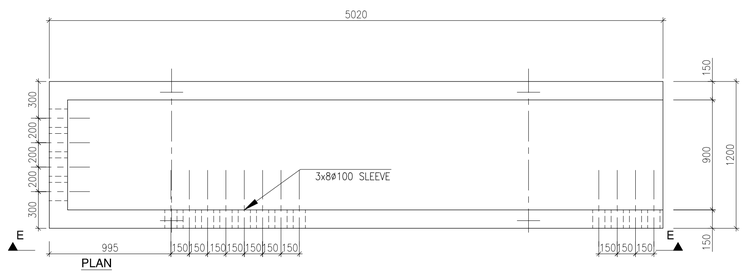
SECTION-A
SHOWING REINF.



ELEVATION E-E



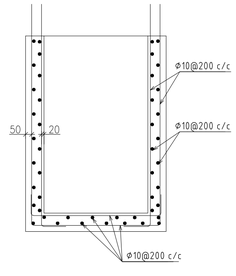
SECTION - A



PLAN

TRENCH - TR2.1AH

Nos. REQD. = 1



SECTION-A
SHOWING REINF.

NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

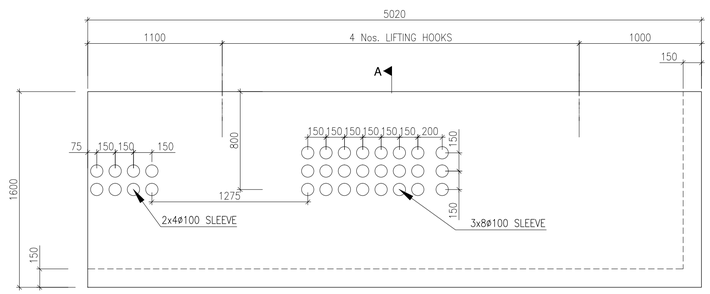
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

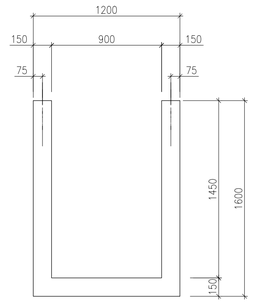
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65679-3

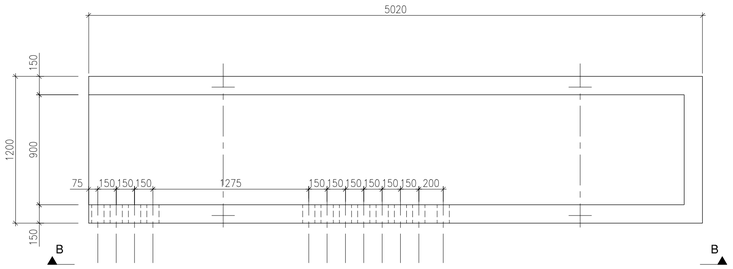
REV. C1



ELEVATION B-B



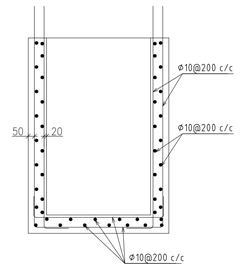
SECTION - A



PLAN

TRENCH - TR2.1A

Nos. REQD. = 1



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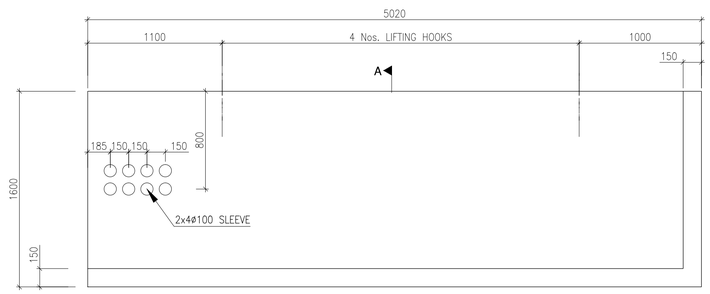
SHOWING REINF.



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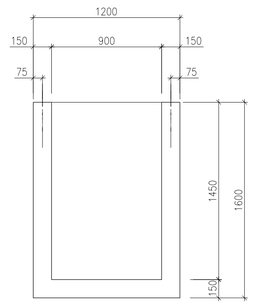

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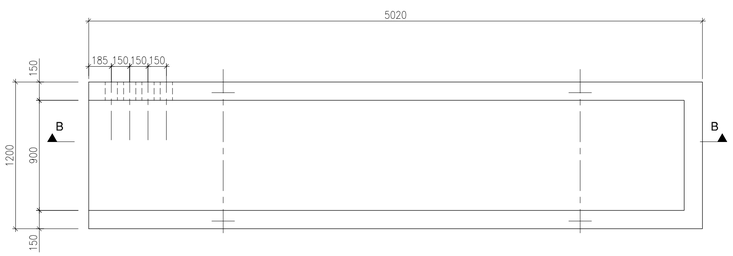

PLAN

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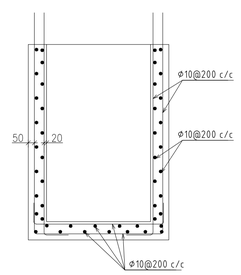

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NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

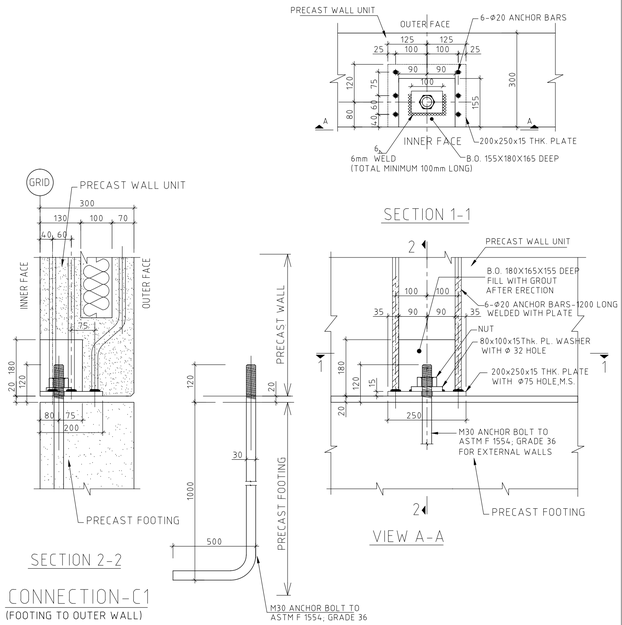
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

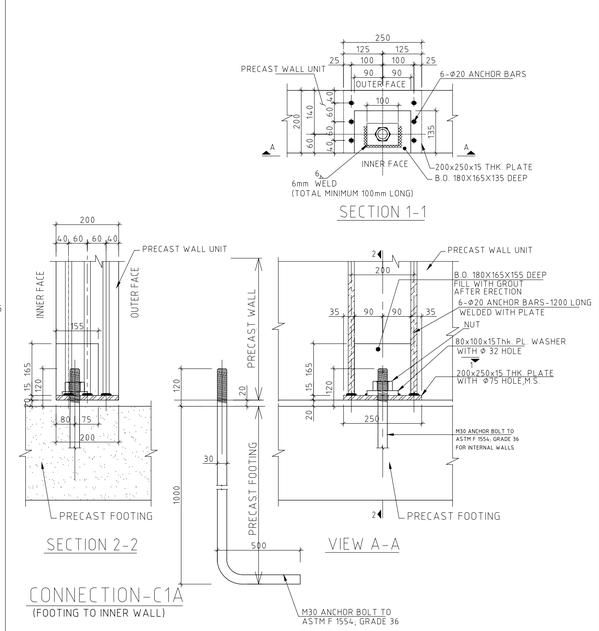
DRAWING NO.

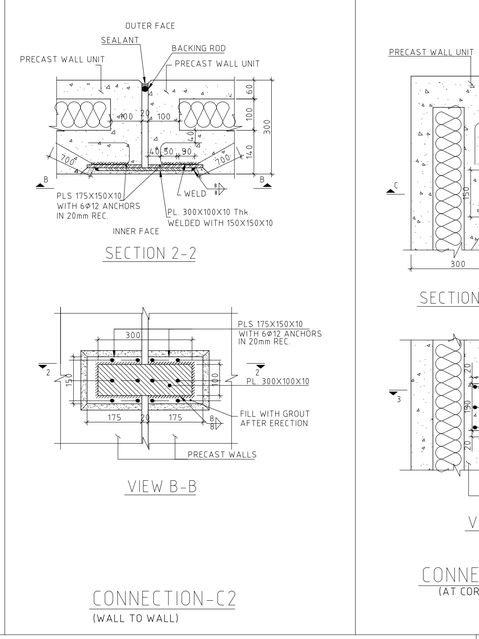
RA140-32-BUI-CW-DW-65679-4

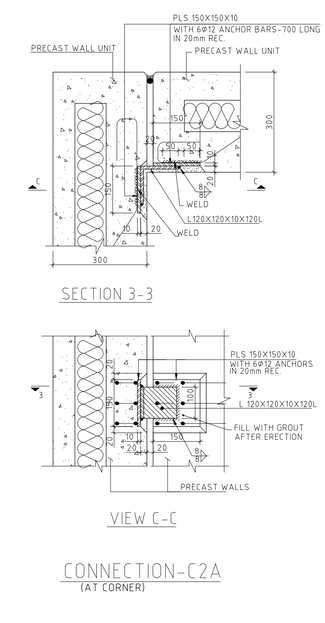
REV.

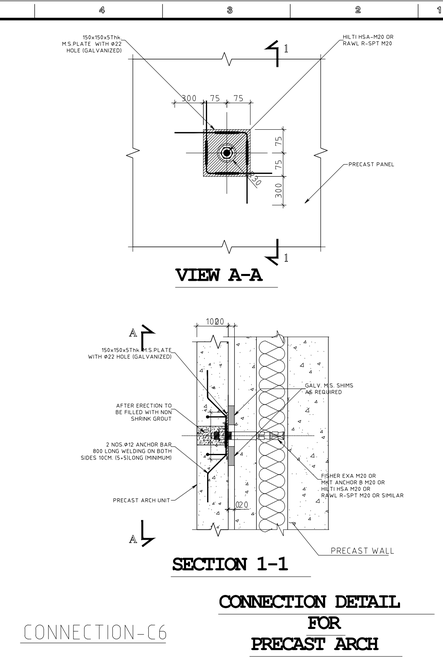
C1



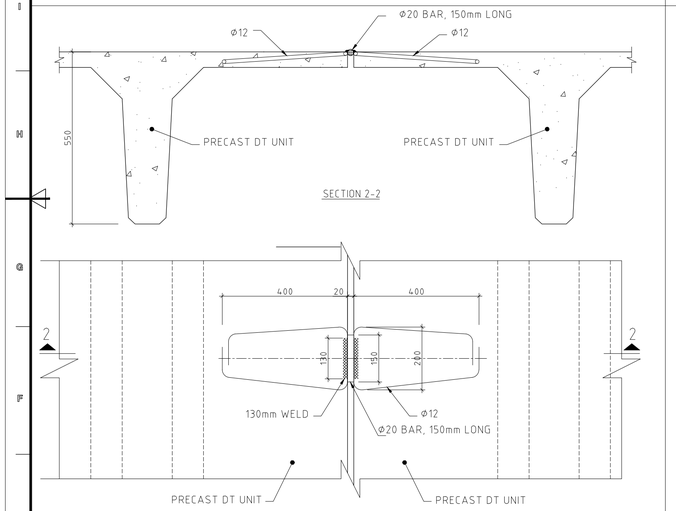


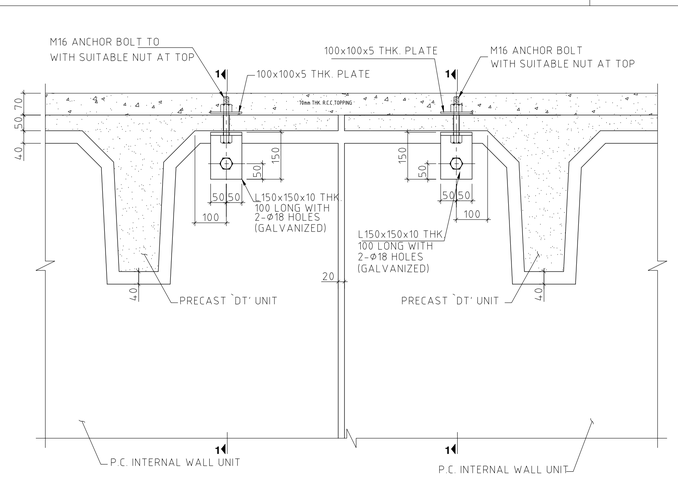


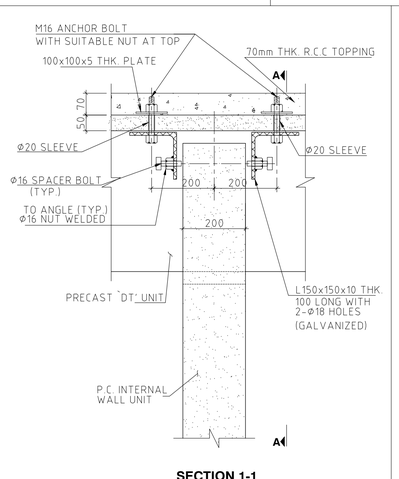


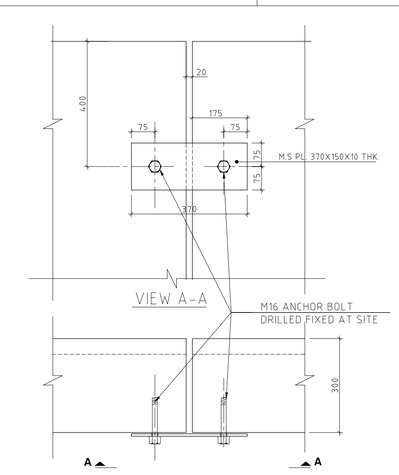


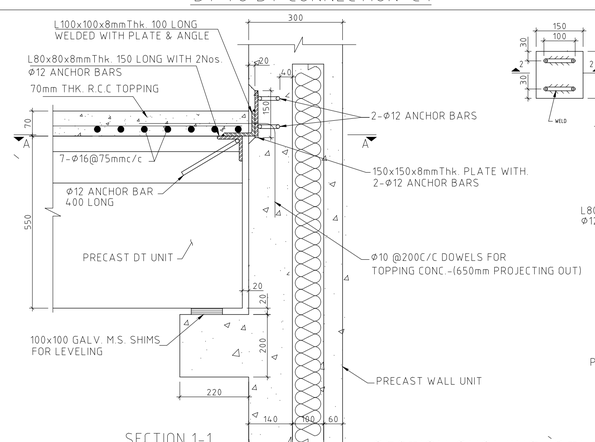
CONNECTION DETAIL FOR PRECAST ARCH

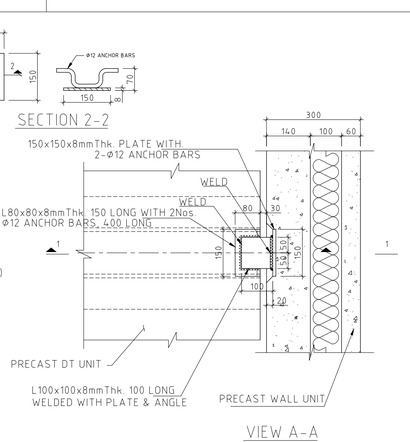


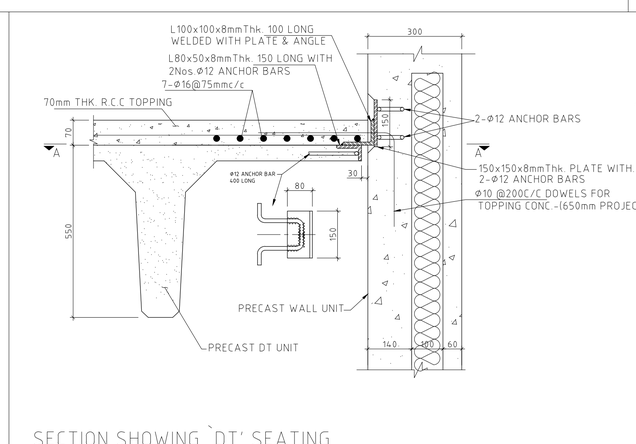


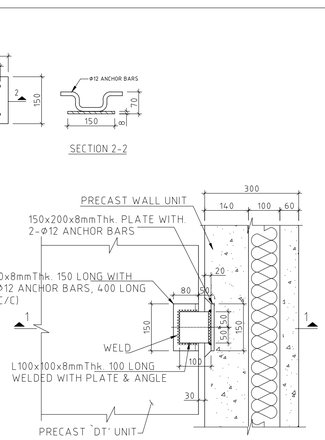












C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
ERECTION PLAN FOOTING AND TRENCHES

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:10	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067

DRAWING NO.

RA140-32-BUI-CW-DW-65680

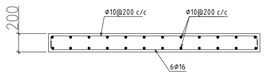
REV.

C1

A0(841X1189mm +-2mm)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



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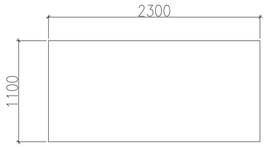
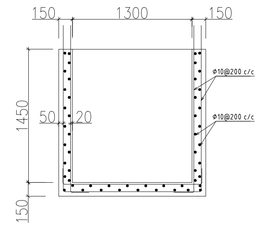
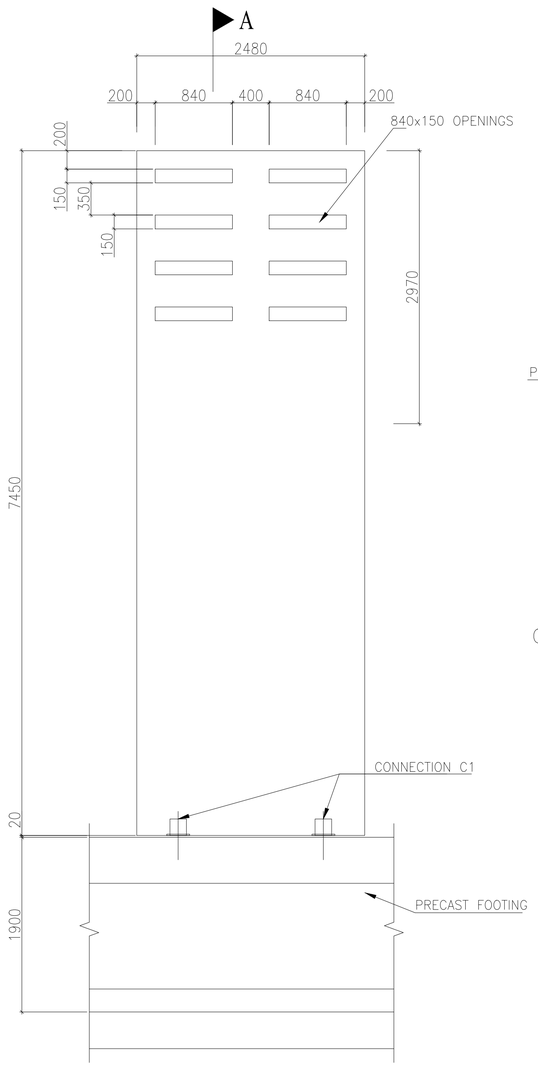


TRANSFORMER SUPPORT SLAB UNIT



TRENCH SECTION



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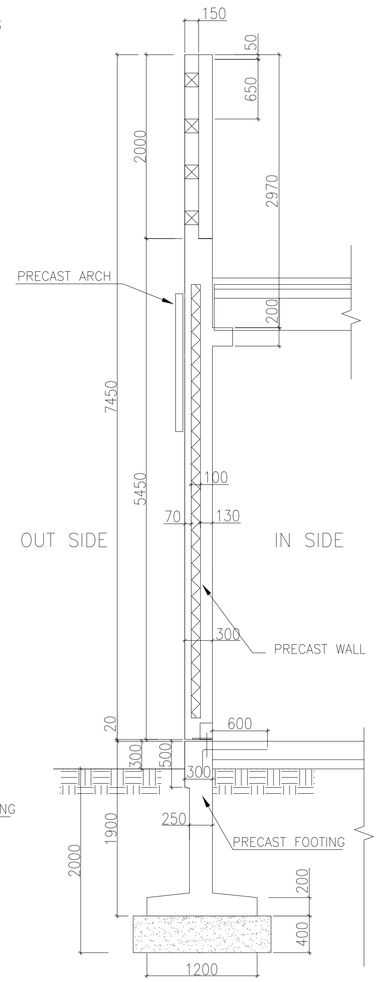

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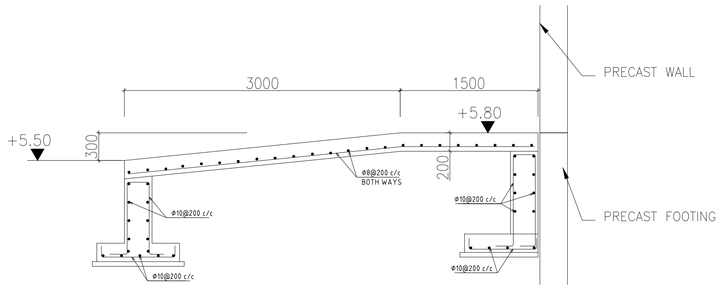

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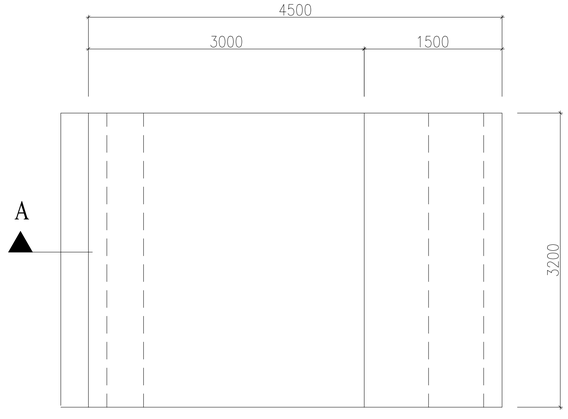


PLAN

RAMP DETAIL

TYPICAL PRECAST WALL DETAILS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
NORTH ISLAND SUBSTATION BSS 1
TYPICAL WALL DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

RA140-32-BUI-CW-DW-65681

REV.

C1

A0(841X1197mm +2mm)

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

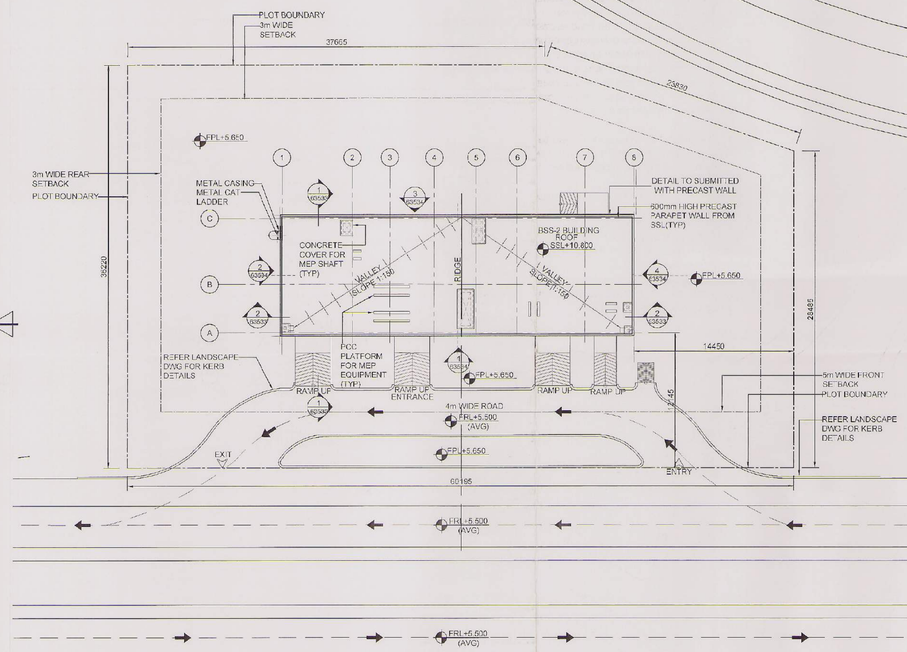
Main Link – Contract RA/140

ADMINISTRATION & FACILITY BUILDINGS - ARCHITECTURE
SUBSTATION BSS-2 (SOUTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-AR-DW-63530-C1

Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-AR-DW-63531	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	SITE PLAN	
RA140-32-BUI-AR-DW-63532	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT – GROUND FLOOR PLAN	
RA140-32-BUI-AR-DW-63533	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT SECTION	
RA140-32-BUI-AR-DW-63534	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT - ELEVATIONS	
RA140-32-BUI-AR-DW-63535	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FLOORING LAYOUTS	
RA140-32-BUI-AR-DW-63536	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	REFLECTED CEILING PLAN	
RA140-32-BUI-AR-DW-63537	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	MISCELLANEOUS DETAILS	
RA140-32-BUI-AR-DW-63538	C1	02/07/17	ADMIN. & FACILITY BUILDING - ARCHITECTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT – ROOF PLAN	

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company



1 SITE PLAN @ BSS-2 BUILDING
SCALE 1:250

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. HT ROOM, TRANSFORMER ROOM ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUE PLATE SHALL NOT BE MORE THAN 300mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISITING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
FGL	FINISH GROUND LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	INGRESS/ EGRESS/ ENTRY/ EXIT
	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER LANDSCAPE DWGS
	SITE BOUNDARY

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
SOUTH ISLAND
SUBSTATION (BSS-2)
SITE PLAN

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

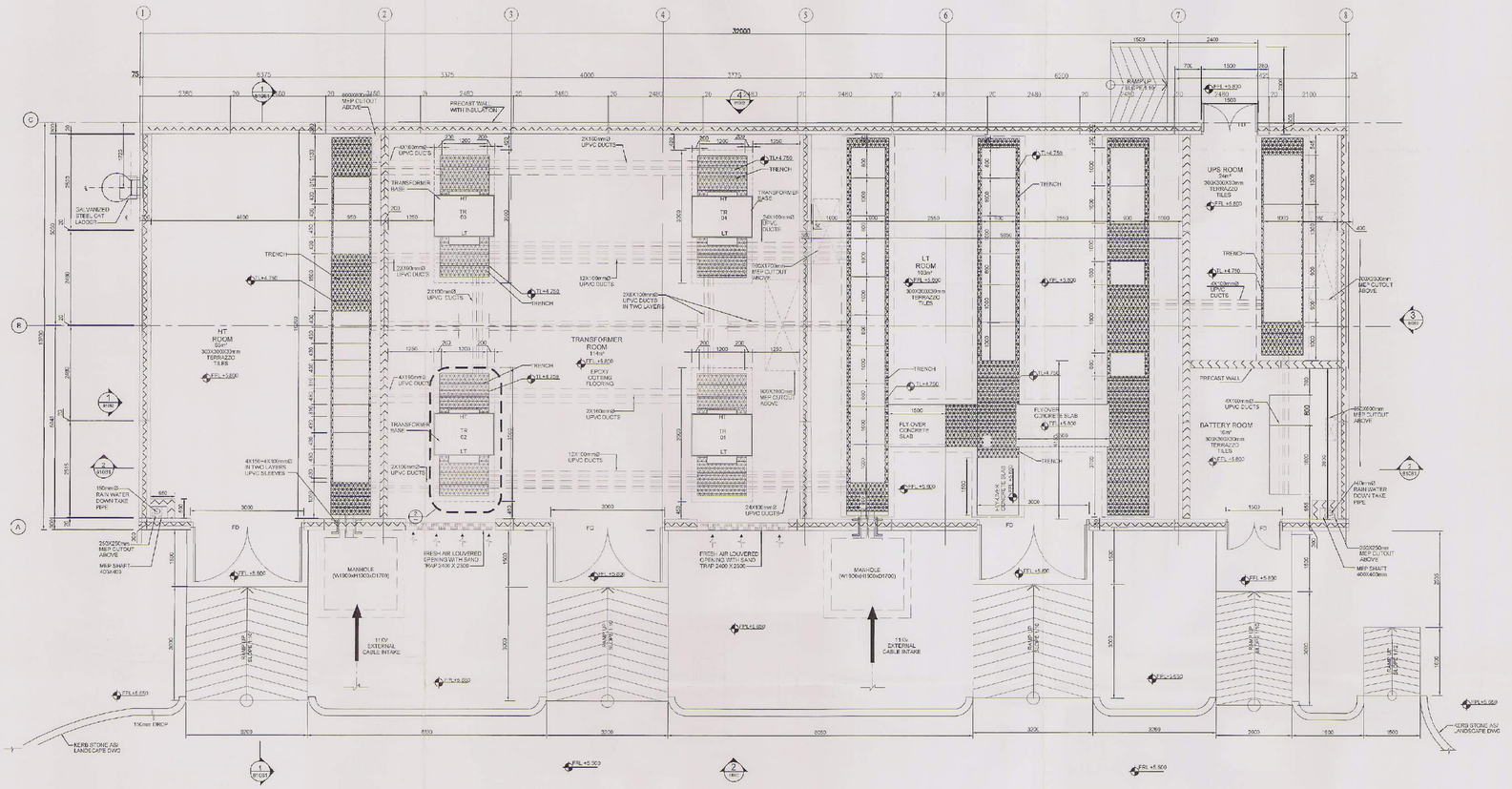
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

NORTH DIRECTION AT BAY ISLAND SOUTH

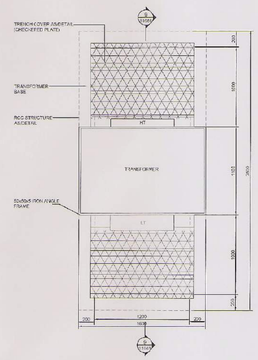
DRAWING NO.
RA140-32-BUI-AR-DW-63531

REV.
C1

A1 (594x841mm +2mm)



1 GROUND FLOOR PLAN
SCALE 1:50



2 TRANSFORMER BASE
SCALE 1:25

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	SCREED
	RCC
	TRENCH COVER
	200mm PRECAST WALL
	360mm PRECAST WALL WITH INSULATION
	FRESH AIR LOUVERED OPENING WITH SAND TRAP 2400X2300

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR CONDITIONED, HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUBSTATION SHALL BE PROVIDED WITH ALTERNATE "D" MAIN PROTECTION SUBJECT TO M.E.W APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKED PLATE SHALL BE 305mm AS PER M.E.W. THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL BUILDING WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL BUENDS AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE AS PER K.F.D REQUIREMENTS.
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER/LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL, MENTIONED ABOVE.
15. PROVIDE HASP AND DOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY, OR SIMILAR.
20. ALL DOORS ARE STEEL DOORS AS MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

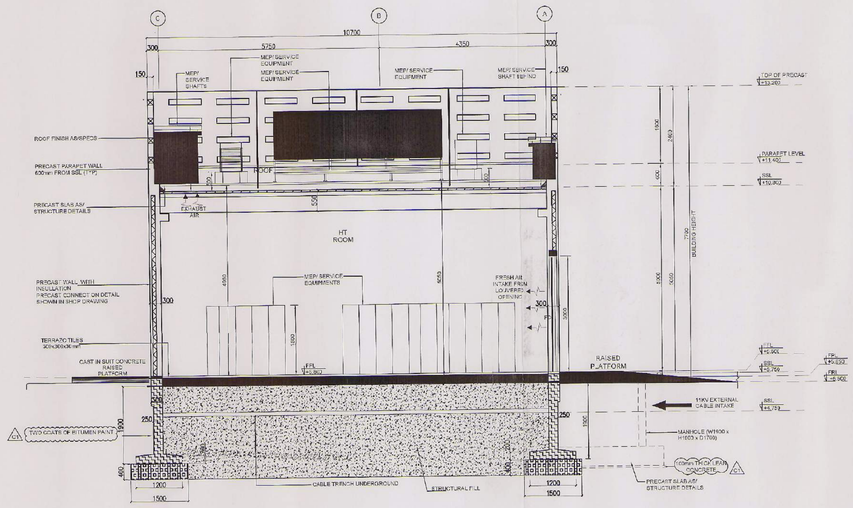
DRAWING TITLE
ADMIN.& FACILITY BUILDING- ARCHITECTURE
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - GROUND FLOOR PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUE				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-53532

REV.
C1



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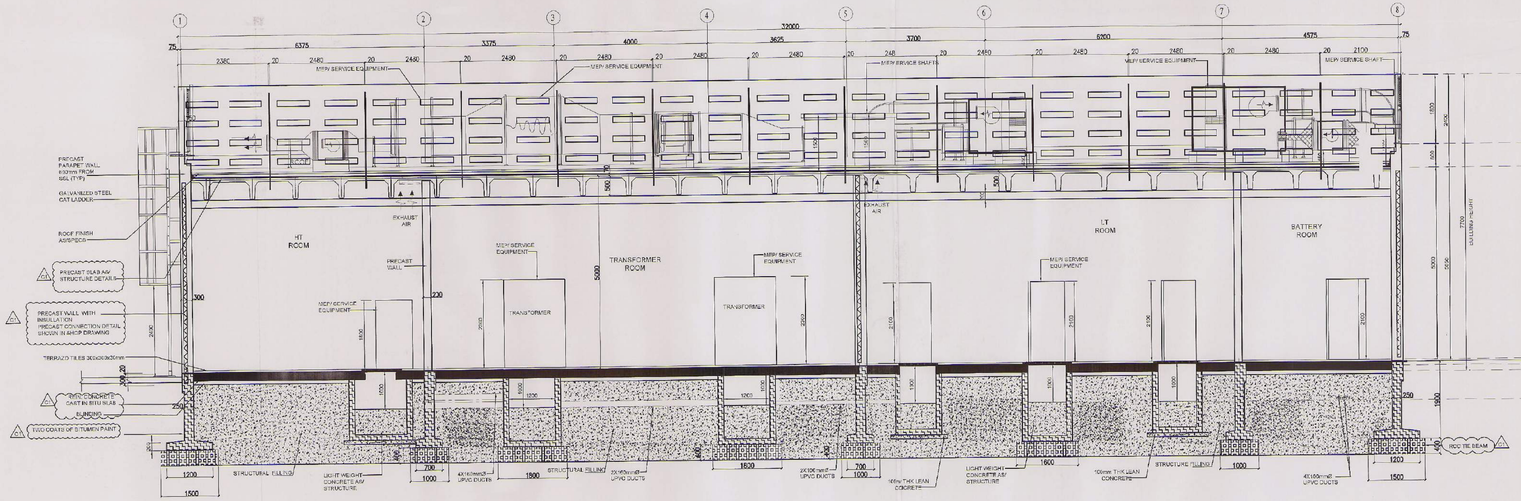


SECTION
SCALE - 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FSL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DISCP LINE

HATCH LEGEND

	FILLING AS/ STRUCTURE
	SCREED
	RCC
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION
	TRENCH COVER
	BLOCK WORK
	RCC TIE BEAM
	LEAN CONCRETE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO MAIN PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL COORDINATE WITH M.E.W. ENGINEER FOR EVECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF LONG AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INSERTION OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE.(AS PER KFD REQUIREMENT)
13. FIRE RESISTING CALMO COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER, LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO M.T.R.S SHALL NOT EXCEED 20 METERS.
18. IT'S CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS ARE PRIMILIMINARY.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BROWN.
20. ALL DOORS ARE STEEL DOORS AS/ MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APP'RD
C	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE
ADMIN & FACILITY BUILDINGS - ARCHITECTURE
SOUTH ISLAND - SUBSTATION / 11kV (BSS-2)
GENERAL ARRANGEMENT - SECTIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

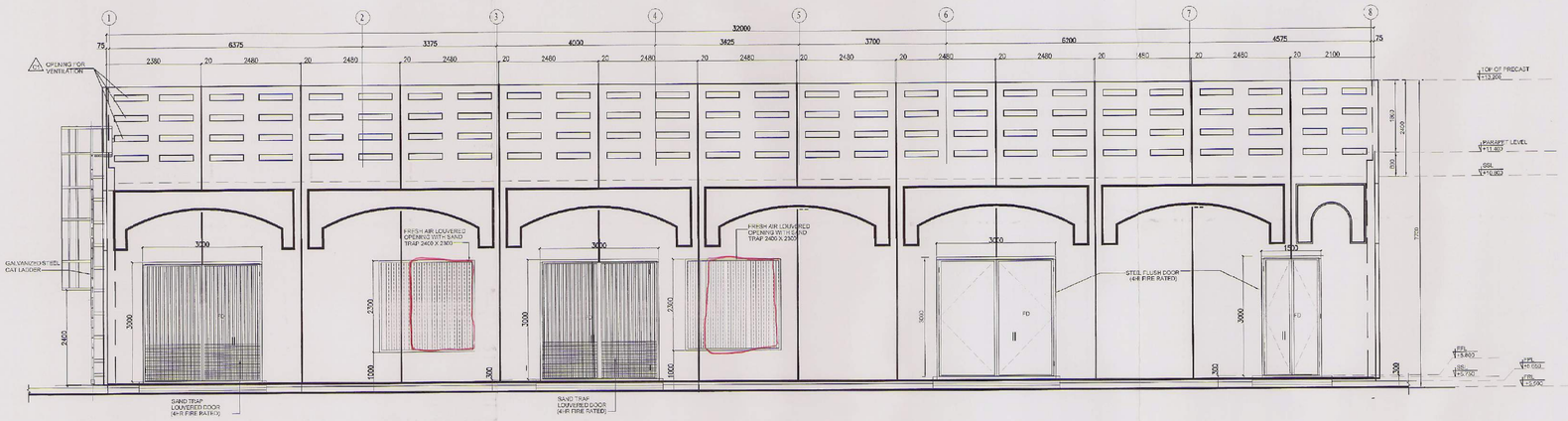
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	03-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63533

REV.
C1

وزارة الكهرباء والماء
إدارة شبكات المنازل الكهربائية
قسم الأعمال المدنية



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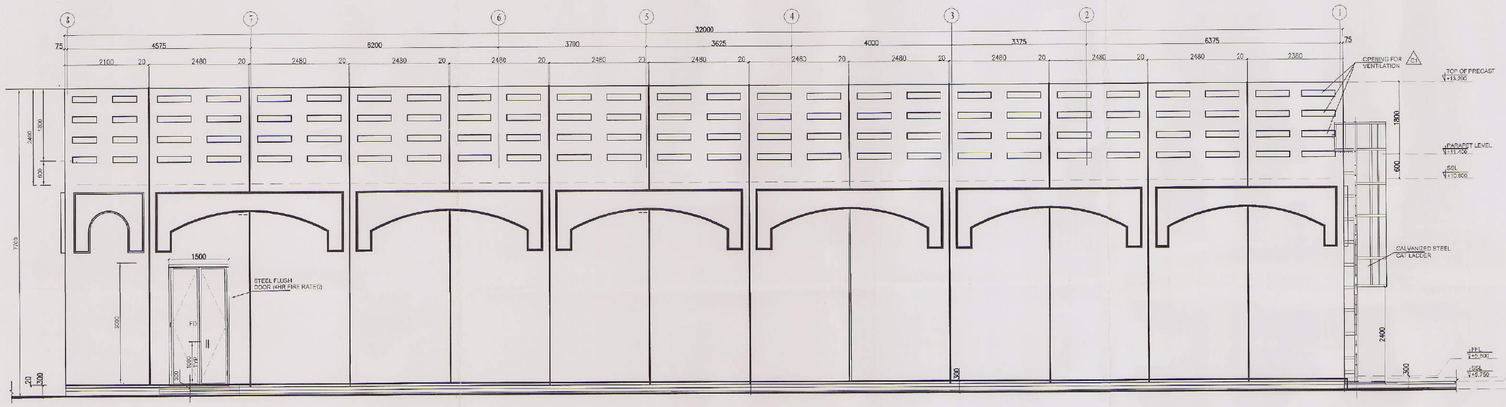

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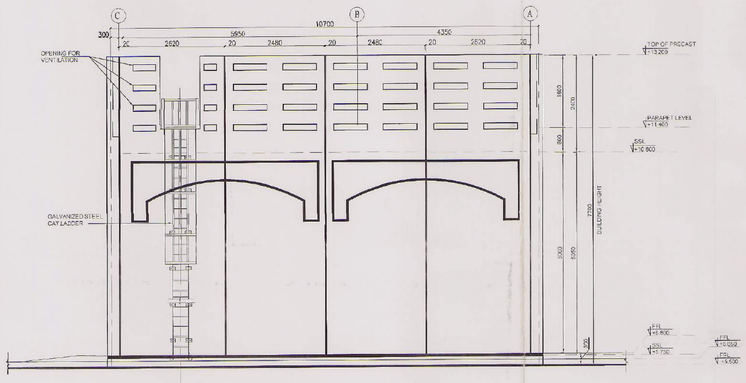

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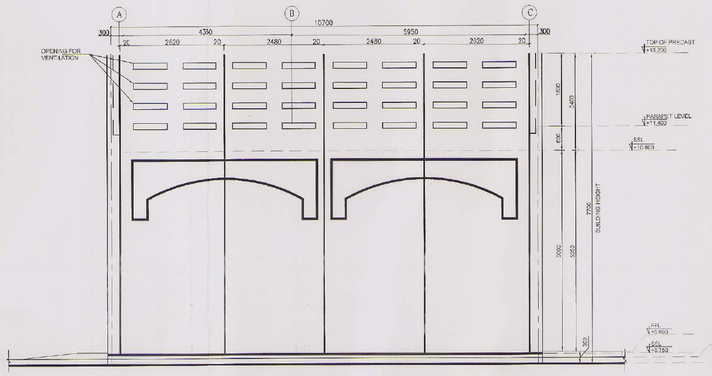

ELEVATION
SCALE : 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FGL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 350mm WIDE SUBJECT TO MUNICIPALITY STANDARD. THICKNESS OF THE PLATE SHALL BE 6mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
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19. ALL INTERIOR SUB DIVIDING WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS PER FIRE REQUIREMENT.
21. ANY VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.
22. ALL WALLS ARE INSULATED.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BOP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

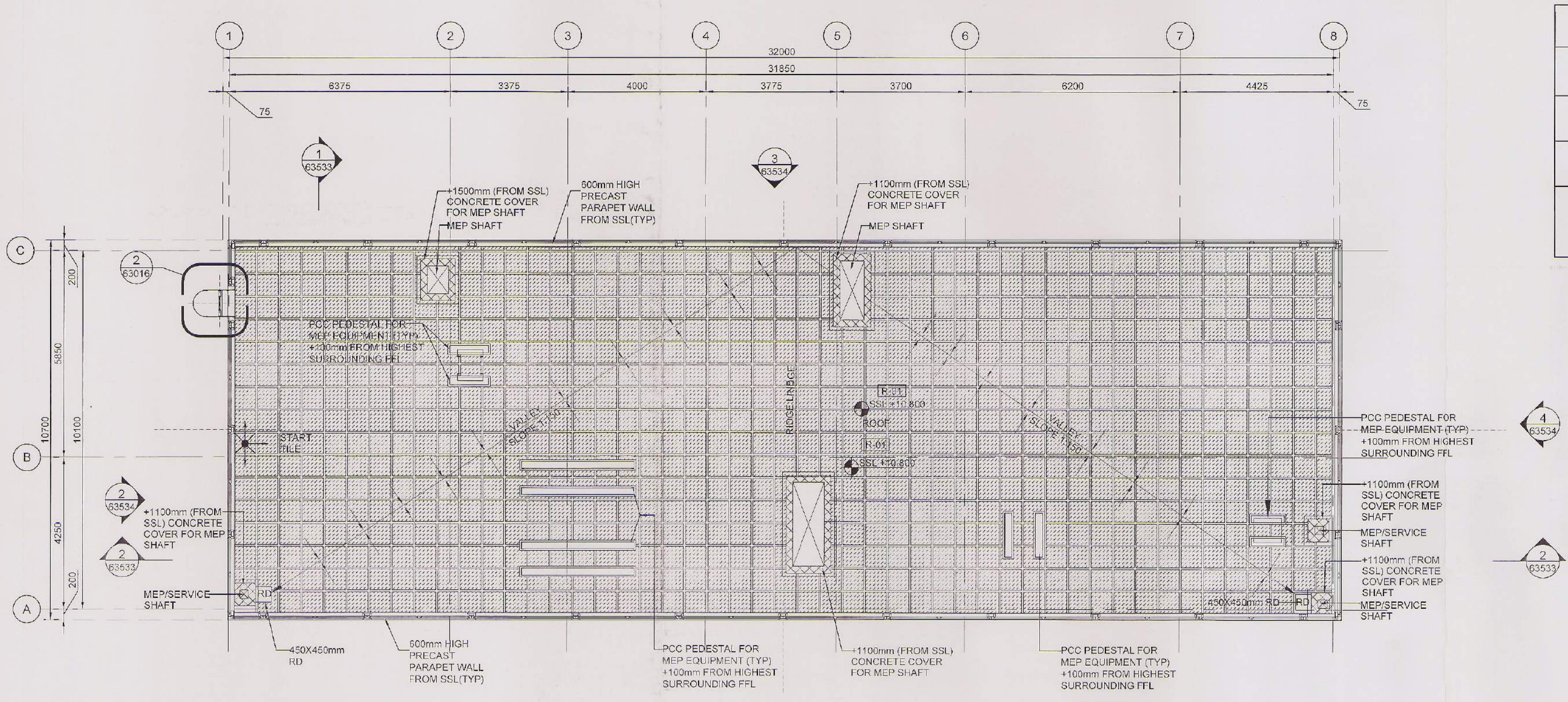
DRAWING TITLE
ADMIN. & FACILITY BUILDING - ARCHITECTURE
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - ELEVATIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BOP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

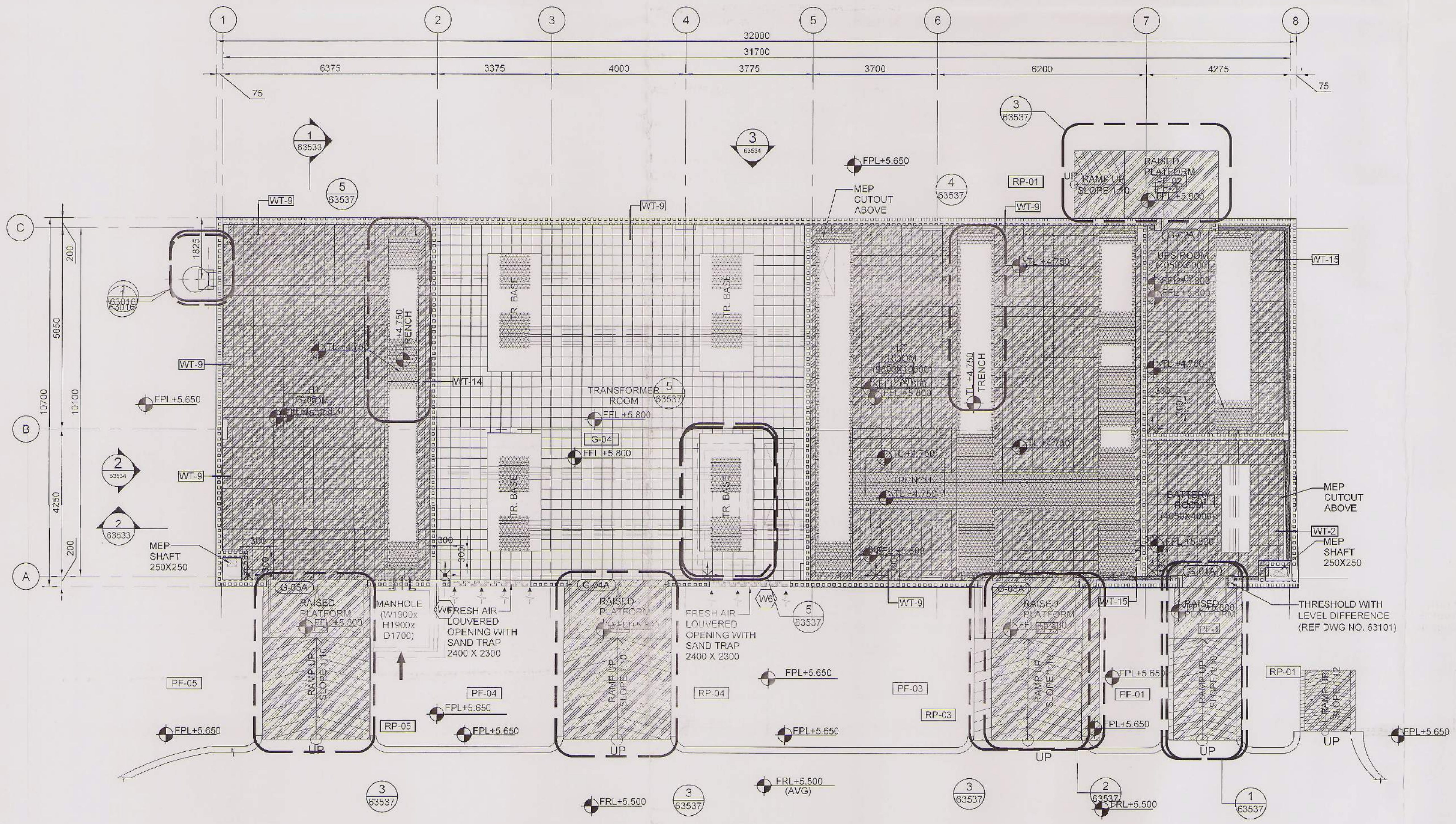
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63534

REV.
C1



2 FLOORING LAYOUT @ ROOF
SCALE 1:100



1 FLOORING LAYOUT @ GROUND FLOOR
SCALE 1:100

FLOORING LEGEND

F10		FLOOR FINISHED WITH EPOXY COATING
F10		ROOF FLOOR FINISH WITH CONCRETE TILE
F11		TERRAZZO TILES SIZE = 300mm X 300mm X30mm
F5		KOTA STONE FLOORING TILE SIZE = 600mm X 600mm
		START TILE

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. HT ROOM, TRANSFORMER ROOM AND LT ROOMS ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
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7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUE PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
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13. FIRE RESISITING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

DRAWING REFERENCES

1. REFER MEP AND STRUCTURE DRAWINGS FOR DETAIL OF RAISED PLATFORM/PEDESTALS PROVIDED TO PLACE MEP EQUIPMENT ON ROOF.
2. REFER DRAWING NO 63001 FOR GENERAL NOTES & ABBREVIATIONS.
3. REFER DRAWING NO 63004, 63005, 63006 FOR TYPICAL DETAIL OF OPENINGS.
4. REFER DRAWING NO 63007 FOR TYPICAL ENLARGED WALL SECTIONS.
5. REFER DRAWING NO 63009 FOR TYPICAL WALL TYPES.
6. REFER DRAWING NO 63010 FOR TYPICAL DETAILS FOR FLOORING.
9. REFER DRAWING NO 63013 FOR TYPICAL DETAILS FOR FALSE CEILING.
10. REFER DRAWING NO 63061 FOR LOCATION OF BUILDING BAY ISLAND NORTH.
11. REFER DRAWING NO 63051 FOR LOCATION OF BUILDING BAY ISLAND SOUTH.
15. REFER DRAWING NO 63535 FOR FLOORING LAYOUT.
16. REFER DRAWING NO 63536 FOR REFLECTED CEILING PLAN.
7. REFER DRAWING NO 63801 FOR SCHEDULE OF OPENINGS & SCHEDULE OF FINISHES
21. REFER DRAWING NO 63537 FOR MISCELLANEOUS DETAILS.
22. REFER LANDSCAPE DRAWINGS FOR EXTERNAL DETAILS.
23. REFER DRAWING NO 63732 FOR DESCRIPTION OF FINISHES.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	200mm THK HOLLOW CONCRETE BLOCK WORK
	200mm THK SOLID BLOCK WORK (4 HRS FIRE RATED)
	150mm THK HOLLOW CONCRETE BLOCK WORK
	100mm THK SOLID CONCRETE BLOCK WORK
	PLASTER
	FILLING AS / STRUCTURE
	200mm THK SOLID CONCRETE BLOCK WORK
	SCREED
	RCC
	12mm THK INTERNAL GYPBOARD
	INSULATION INFILL AS/SPECIFICATION
	PRECAST WALL & ROOF

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	10/04/17	FOR CONSTRUCTION	YJB	NBN	KRC

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

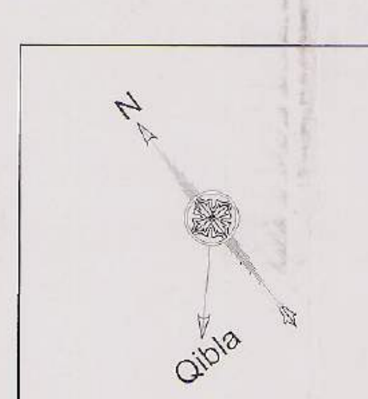
DRAWING TITLE

ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
SOUTH ISLAND
SUBSTATION (BSS-2)
FLOORING LAYOUTS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	YJB	KRC	NBN	KRC
DATE ISSUED				
10/04/17	10/04/17	10/04/17	10/04/17	10/04/17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

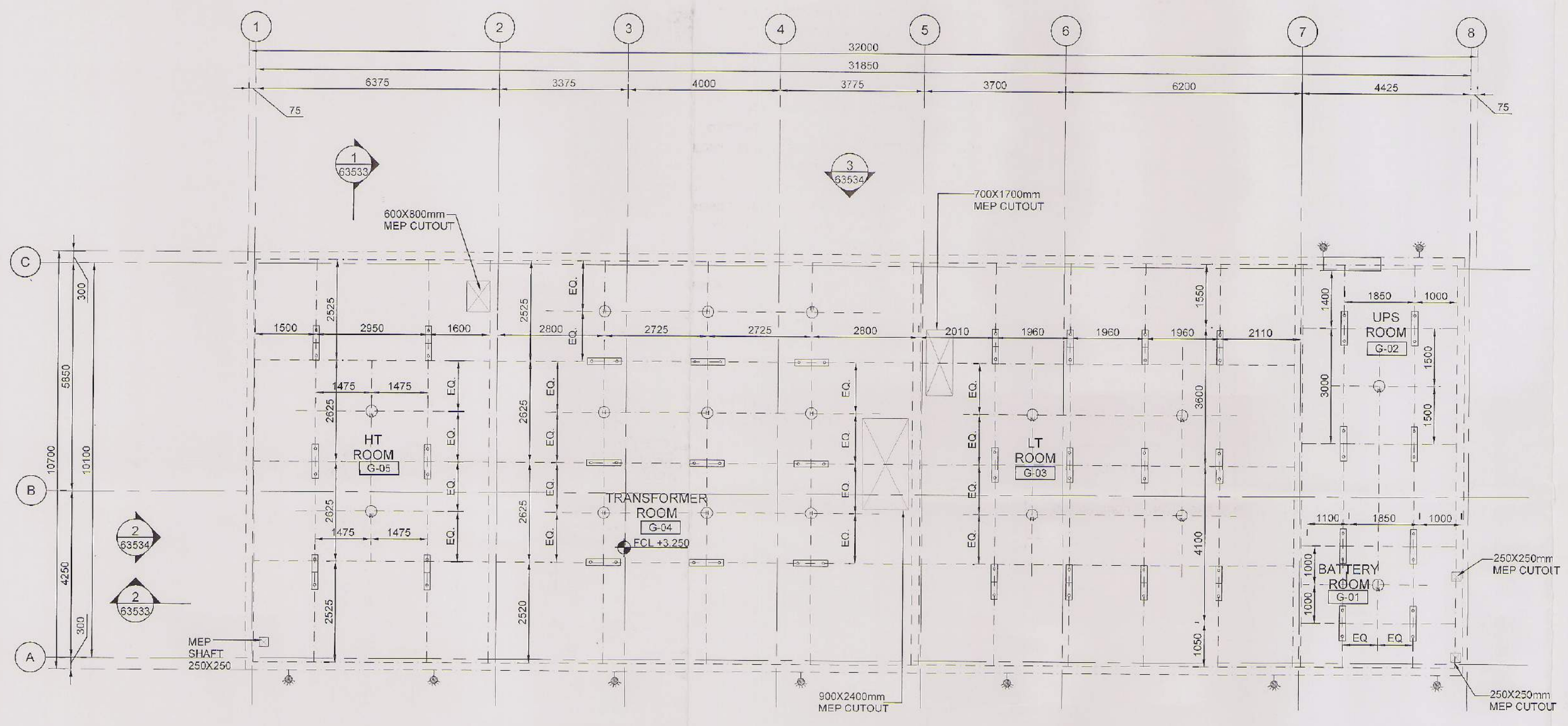


NORTH DIRECTION AT BAY ISLAND SOUTH

DRAWING NO. RA140-32-BUI-AR-DW-63535

REV. C1

A1(594x841mm +2mm)



REFLECTED CEILING PLAN @ GROUND FLOOR
SCALE 1:100

HVAC LEGEND	
SYMBOL	DESCRIPTION
	SUPPLY AIR DIFFUSER
	RETURN AIR DIFFUSER
	DISC VALVE EXHAUST
	ACCESS PANEL
	CASSETTE UNIT
FIRE FIGHTING LEGEND	
	PENDENT SPRINKLER HEAD
H	HEAT DETECTOR
RI	RESPONSE INDICATOR WITH TWIN HIGH INTENSITY LEDS
	NOZZLE (360°-FEMALE THREADED) (ROOM & CEILING VOID)
M	MULTI SENSOR OPTICAL SMOKE THERMISTOR BASED CUM HEAT DETECTOR
S	SMOKE DETECTOR
ELECTRICAL LEGEND	
	4x14W FLUORESCENT FIXTURE RECESS TYPE
	4x14W FLUORESCENT FIXTURE RECESS TYPE
	2x18 W CFL RECESS MOUNTED DOWN LIGHTER
	2x28W SUSPENDED MOUNTED LIGHT FIXTURE
	2x28W RECESS MOUNTED LIGHT FIXTURE
	2x26W CFL RECESS MOUNTED DOWN LIGHTER
	2x18W CFL SURFACE MOUNTED DOWN LIGHT FIXTURE
	HIGH WALL UNIT (IDU)
IDU	PRECISION AIR CONDITIONING INDOOR UNIT
	SQUARE SUPPLY GRILLE
	SQUARE RETURN GRILLE / EXHAUST GRILLE

SHEETS NOTES

1. ALL FINISHED FALSE CEILING LEVELS ARE FROM THE RESPECTIVE FINISHED FLOOR LEVEL (FFL)
2. ALL SPACES WHERE RCC WITH INTERIOR GRADE PLASTER & PAINT FINISH AS/SPECIFICATIONS IS MARKED, SHALL NOT HAVE ANY FALSE CEILING.
3. ALL TYPES OF FALSE CEILINGS SHALL BE INSTALLED AS PER SPECIFICATIONS.
4. WHEREVER GYPSUM BOARD CEILING IS USED IN ANY WET AREA IT SHALL BE MOISTURE RESISTENT GYPSUM BOARD ONLY.
5. ALL MEP FIXTURES IN ROOMS WITH CEILING TILES SHALL BE LOCATED IN CENTRE OF TILE.

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. HT ROOM, TRANSFORMER ROOM AND LT ROOMS ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUE PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
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13. FIRE RESISITING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

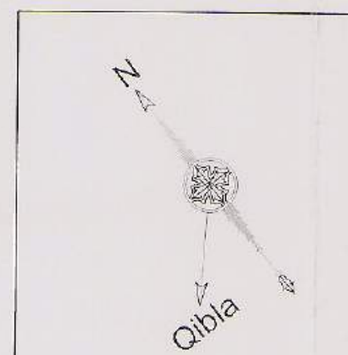
PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
SOUTH ISLAND
SUBSTATION (BSS-2)
REFLECTED CEILING PLAN

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17



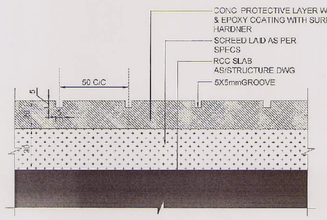
NORTH DIRECTION AT BAY ISLAND SOUTH

CONTRACTOR

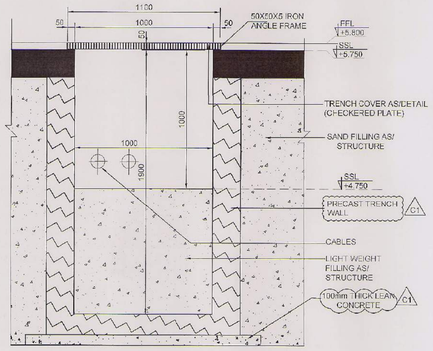
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.: RA140-32-BUI-AR-DW-63536

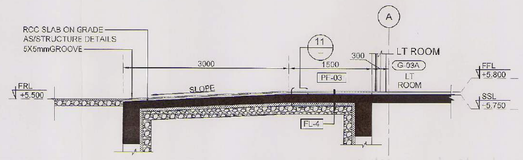
REV.: C1



11 DETAIL
SCALE 1:2



10 TYPICAL TRENCH DETAIL
SCALE 1:20



8 SECTION
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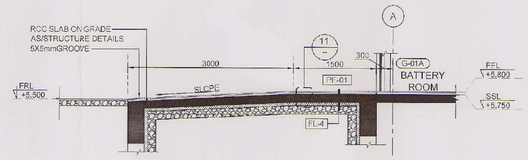

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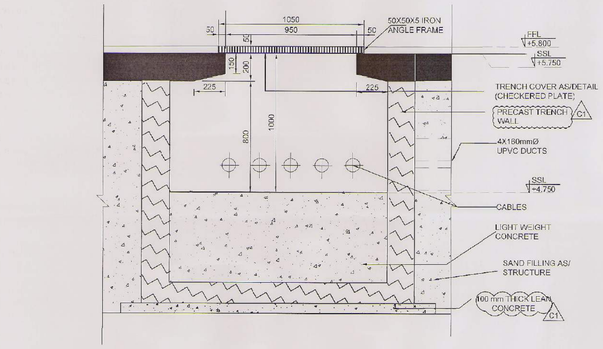
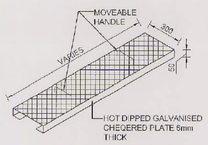
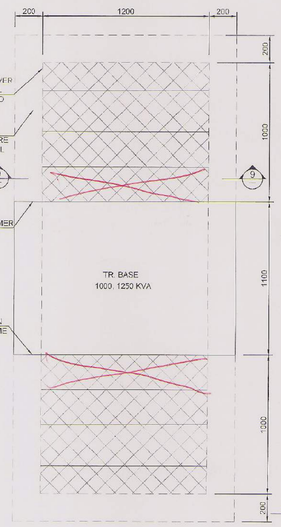


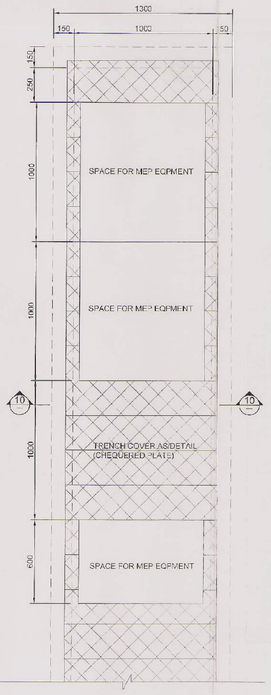
9 TYPICAL 11KV TRENCH DETAILS (TYP)
SCALE 1:20



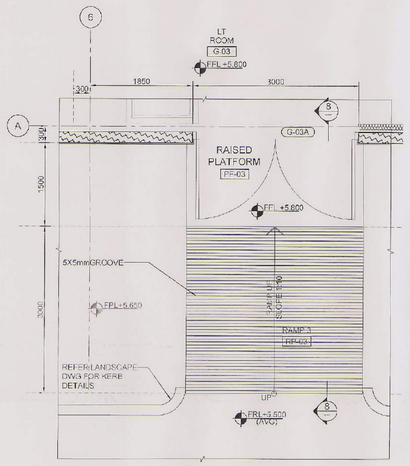
12 TYPICAL TRENCH COVER
SCALE 1:20



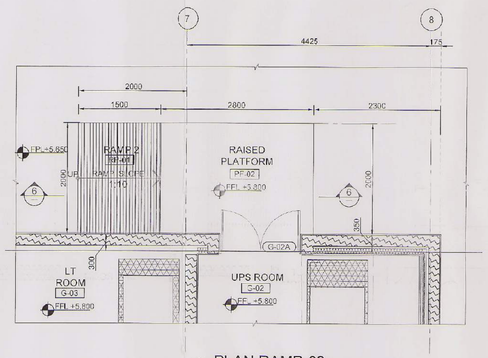
5 TYPICAL TRENCH PLAN-2
SCALE 1:20



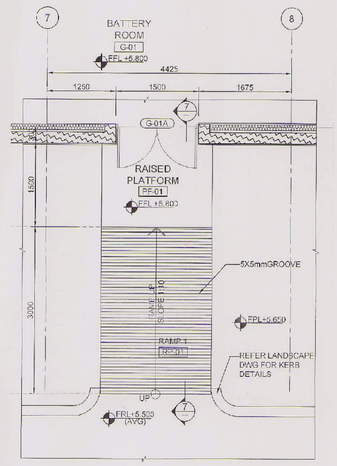
4 TYPICAL TRENCH PLAN-1
SCALE 1:20



3 PLAN RAMP-03
SCALE 1:50



2 PLAN RAMP-02
SCALE 1:50



1 PLAN RAMP-01
SCALE 1:50

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. HT ROOM, TRANSFORMER ROOM AND LT ROOMS ARE VENTILATED AND OTHER ROOMS ARE AIR CONDITIONED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUE PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL/ STANDARD.THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING, FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	200mm THK SOLID BLOCK WORK (4 HRS FIRE RATED)
	150mm THK HOLLOW CONCRETE BLOCK WORK
	PLASTER
	FILLING AS / STRUCTURE
	200mm THK SOLID CONCRETE BLOCK WORK
	SCREED
	RCC
	12mm THK INTERNAL GYPBOARD
	INSULATION INFILL AS/SPECIFICATION
	PRECAST WALL & ROOF

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN. & FACILITY BUILDINGS - ARCHITECTURE
SOUTH ISLAND
SUBSTATION (BSS-2)
M SCELLANEOUS DETAILS

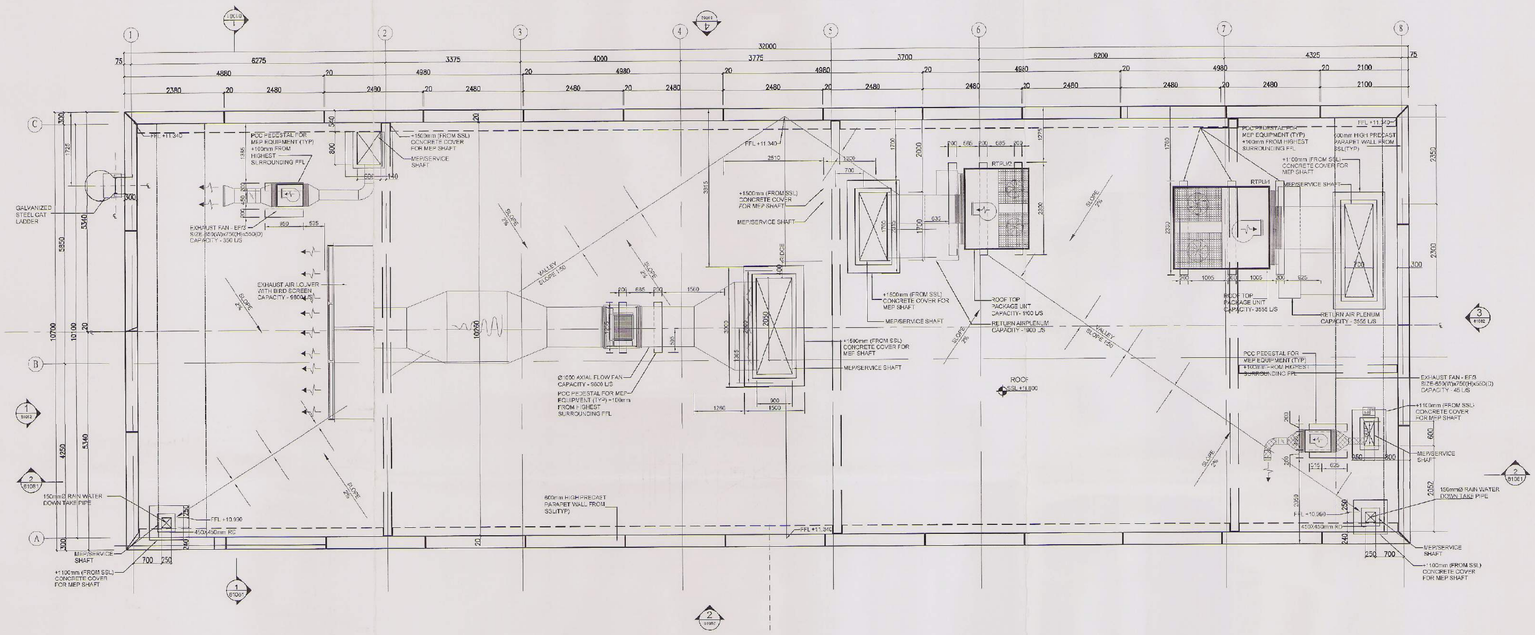
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63537

REV.
C1

A1(594x841mm - 2mm)



1 ROOF PLAN
SCALE 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FFL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	FILLING AS / STRUCTURE
	SCREED
	RCC
	TRENCH COVER
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2 HOURS AS PER K.P.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 25mm WIDE SUBJECT TO MEW APPROVAL. / STANDARD THICKNESS OF THE PLATE SHALL BE 6mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH. (IN CASE OF HRV GAS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL AS MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LV CABLE FROM TRANSFORMER TO MLTP'S SHALL NOT EXCEED 25 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BROWN.
20. ALL DOORS ARE STEEL DOORS AS PER M.E.W. REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	E/L	HSH	DCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN. & FACILITY BUILDING - ARCHITECTURE
SOUTH ISLAND - SUESTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - ROOF PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	E/L	JSK	HSH	DCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION | Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-63538

REV.
C1

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

BUILDING ARCHITECTURE – AUTHORITY SUBMITTALS
SUBSTATION BSS-2 (SOUTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-AR-DW-81075-C1

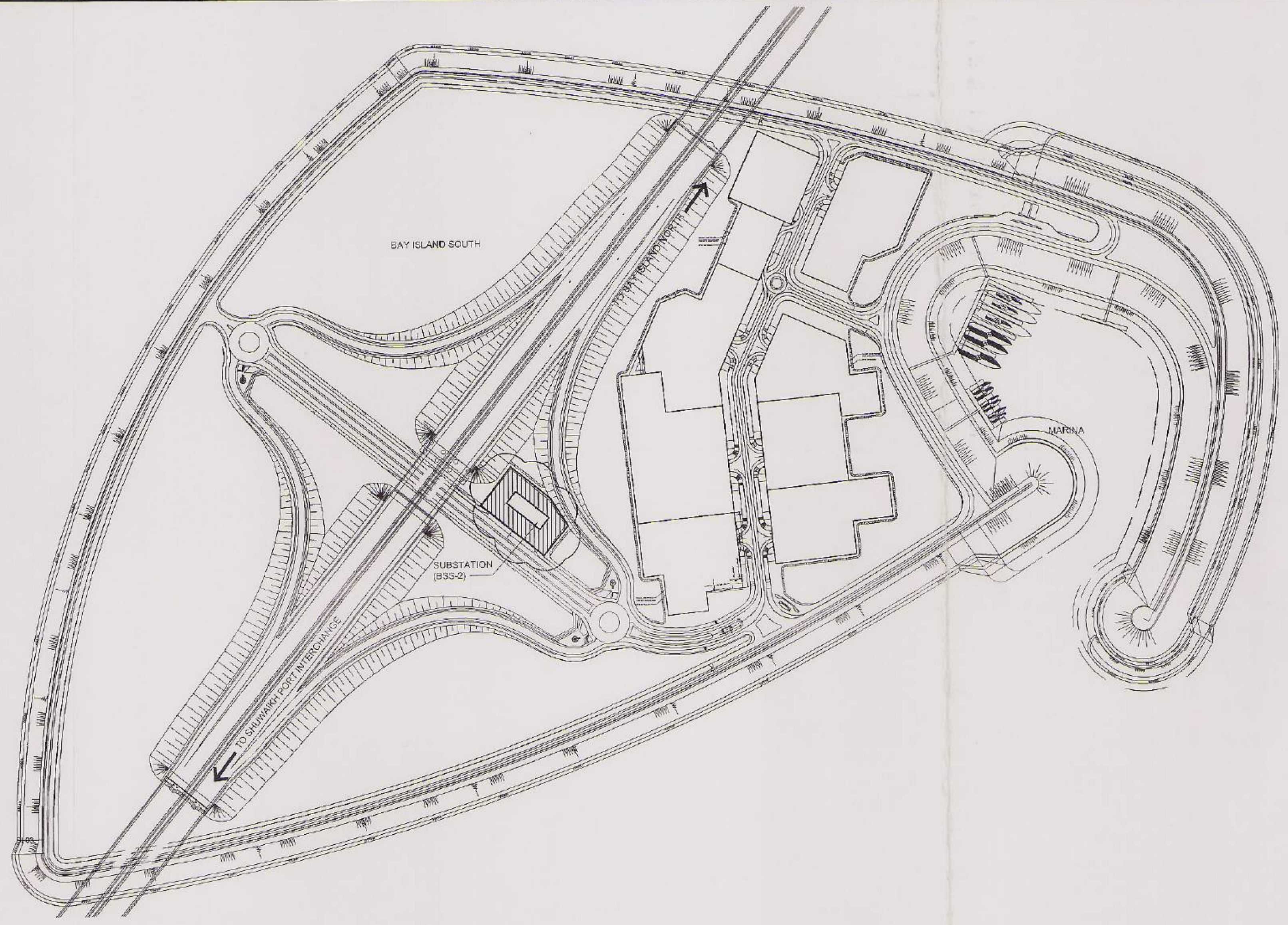
Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-AR-DW-81075	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	SITE LOCATION LAYOUT	
RA140-32-BUI-AR-DW-81076	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	ACCESS ROAD LAYOUT	
RA140-32-BUI-AR-DW-81077	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	ROAD LAYOUT – DIMENSION PLAN	
RA140-32-BUI-AR-DW-81078	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	AREA CALCULATION	
RA140-32-BUI-AR-DW-81079	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT – GROUND FLOOR PLAN	
RA140-32-BUI-AR-DW-81080	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT – ROOF PLAN	
RA140-32-BUI-AR-DW-81081	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT - SECTION	
RA140-32-BUI-AR-DW-81082	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT - ELEVATION	
RA140-32-BUI-AR-DW-81083	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	LIFE SAFETY PLAN	
RA140-32-BUI-AR-DW-81084	C1	02/07/17	ARCHITECTURE – AUTHORITY SUBMITTAL	SOUTH ISLAND	SUBSTATION (BSS-2)	GENERAL ARRANGEMENT – TRAFFIC MARKING	

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

Project Information بيانات المشروع	
Sheikh Jaber Al-Ahmed Al-Sabah Causeway (Main Link)	Project Name
Ministry of Public Works	Client Name
Systra	International Consultant
The Hyundai- CGC Consortium	The Main Contractor
Pace	Local Consultant
BSS-2 Building	Building Name
South Island	The Address
	Survey Plan No.
2094m²	Plot Area
342.40m² 16.35 %	Total Building area/Building Ratio
G	Floor No.
7.700m	Building Height
New permit	Proposed permit Such as (New building permit or revised permit)

Building's areas schedule

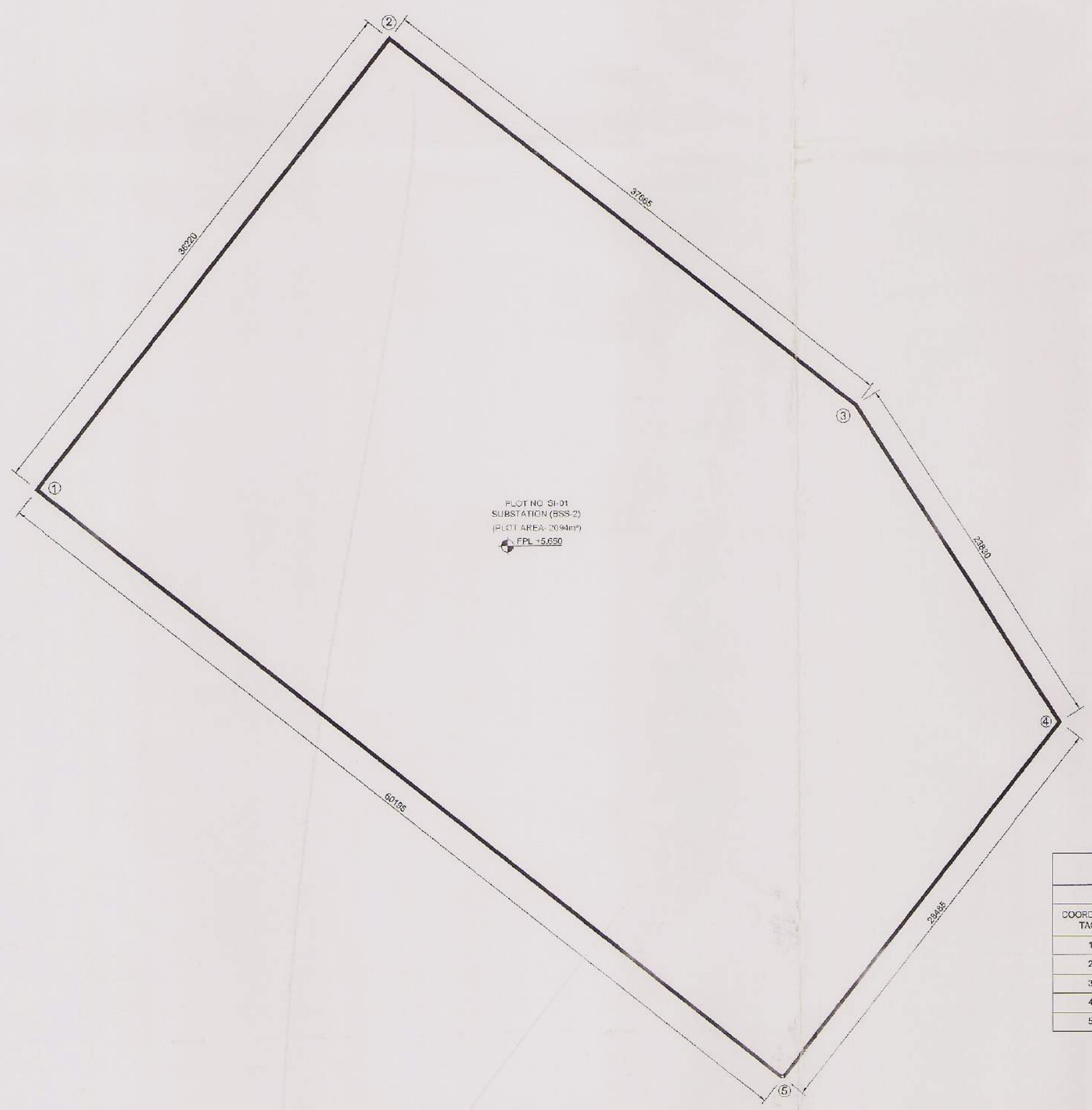
Comments	Total Area	Services Areas	Used Areas	Floor	Sr.
BSS-2 Building	342.40	0.124	342.276	Ground Floor/ FFL +5.800m	1
	342.40		342.276	Total Areas	2



KEY PLAN - BAY ISLAND SOUTH

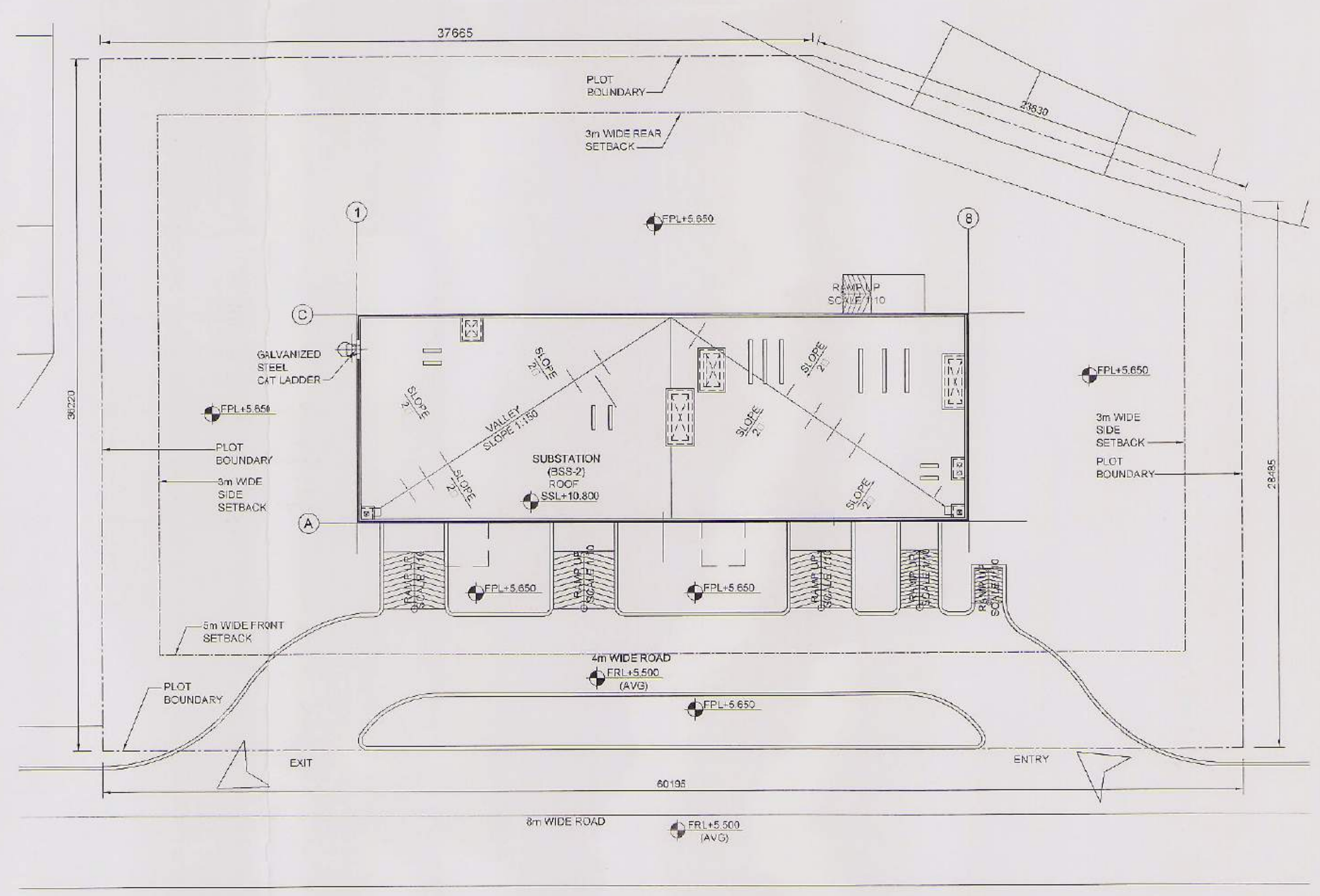
KEY PLAN - KUWAIT CITY - SUBURBS

SCALE - NTS



LEVEL PLAN - SUBSTATION (BSS-2)

SITE COORDINATES SECONDARY SUBSTATION BSS-2		
PLOT NO SI-01		
COORDINATE TAGS	NORTHING	EASTING
1	3253449.403	493409.110
2	3253477.819	493431.566
3	3253454.481	493461.132
4	3253434.425	493474.001
5	3253412.079	493456.338



SITE PLAN - SUBSTATION (BSS-2)

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
SITE LOCATION LAYOUT
ARCHITECTURE - AUTHORITY SUBMITTAL

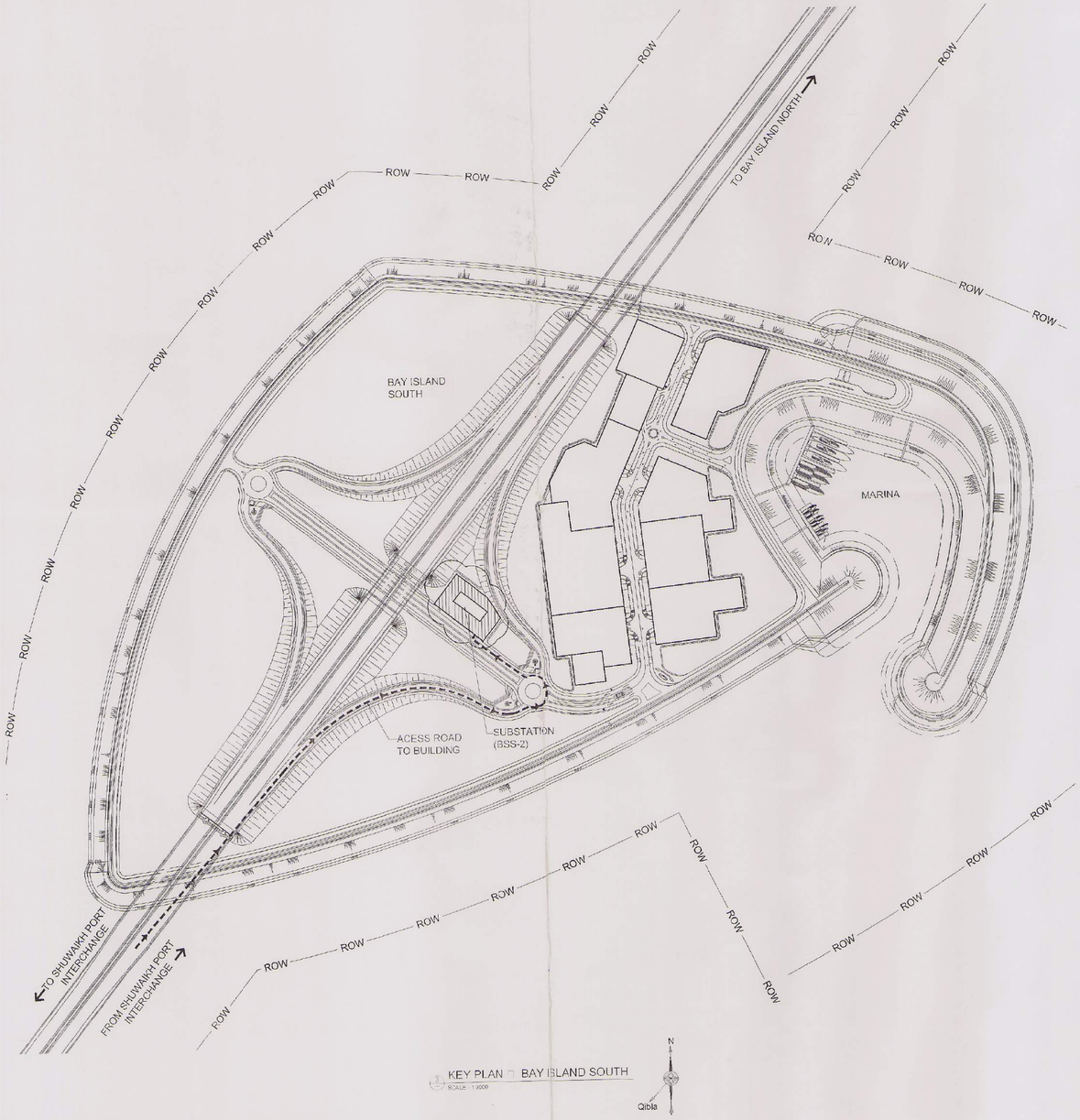
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

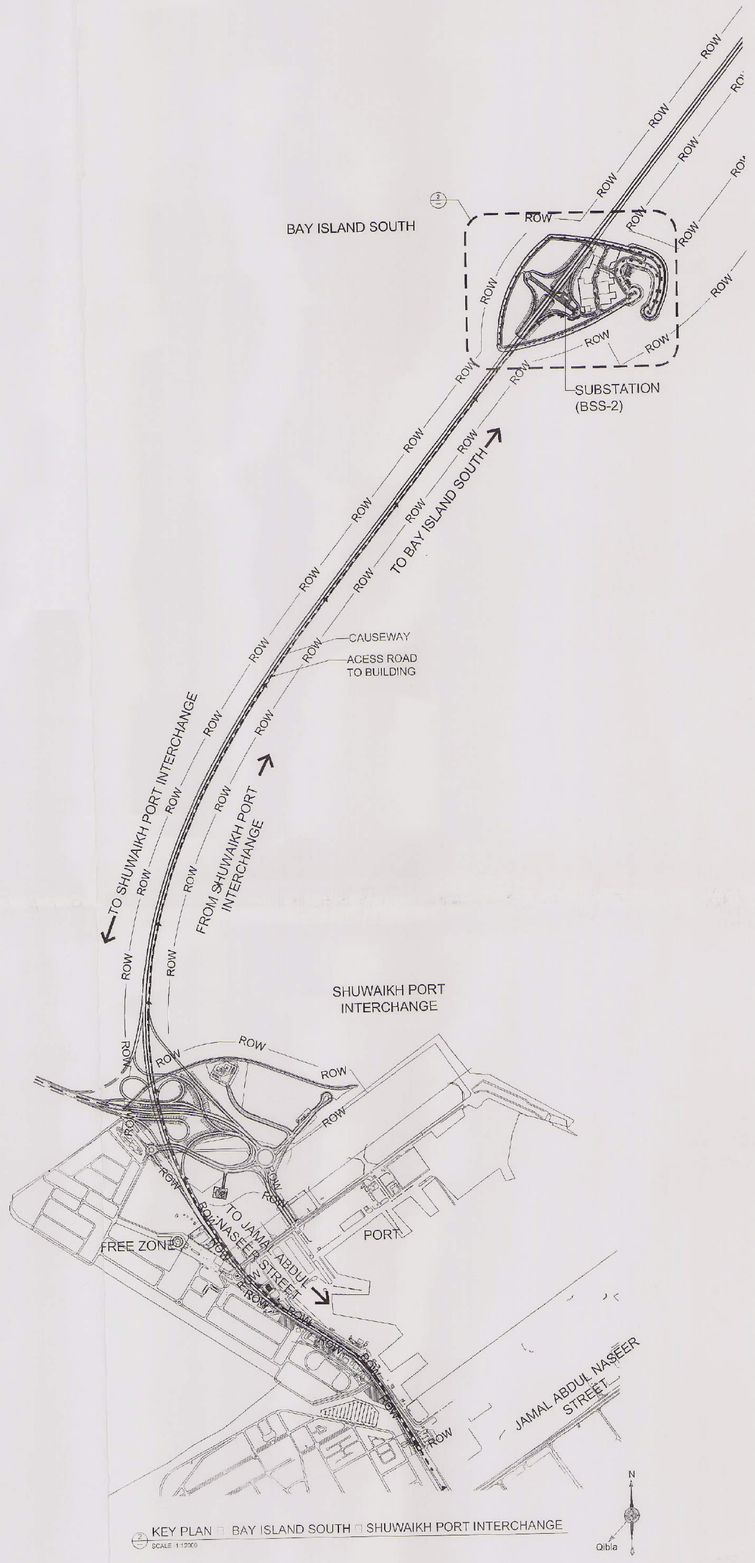
DRAWING NO. RA140-32-BUI-AR-DW-81075

REV. C1



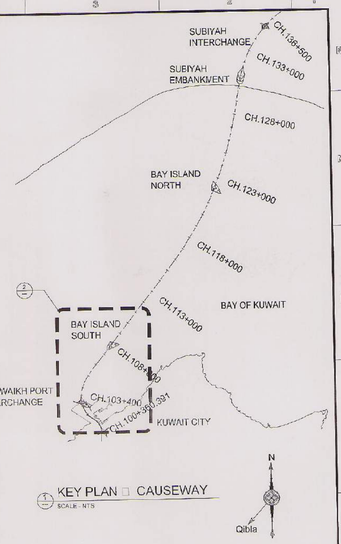
KEY PLAN □ BAY ISLAND SOUTH
SCALE: 1:2000

Qibla



KEY PLAN □ BAY ISLAND SOUTH □ SHUWAIKH PORT INTERCHANGE
SCALE: 1:12000

Qibla



KEY PLAN □ CAUSEWAY
SCALE: NTS

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

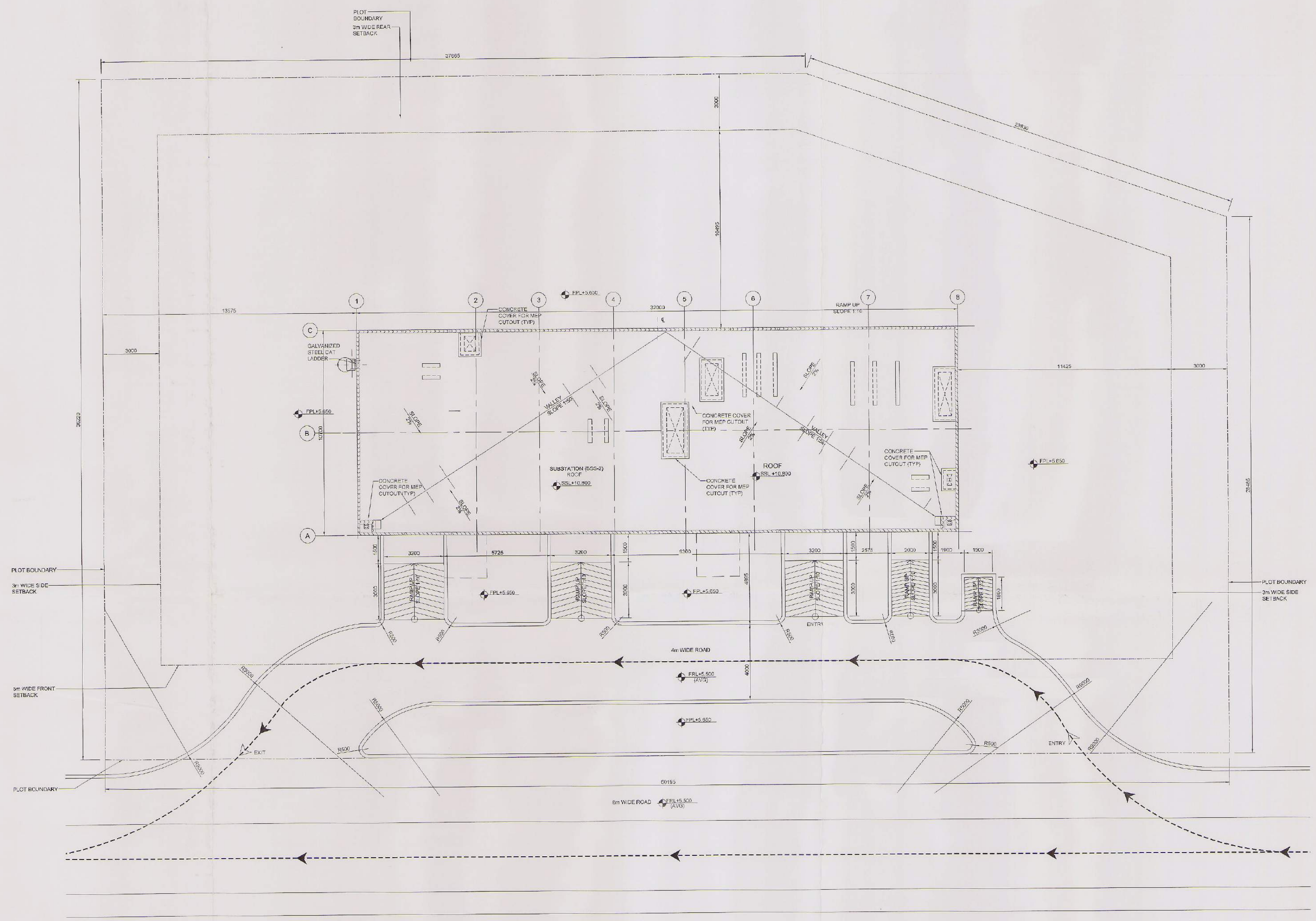
DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
ACCESS ROAD LAYOUT
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-81076

REV
C1



ROAD LAYOUT (DIMENSIONS PLAN) □ SUBSTATION BSS-2
SCALE - 1:100

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN MILLIMETERS □ ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING FIRE FIGHTING, AIR-CONDITIONING □ STRUCTURE DRAWINGS □ ROAD □ EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

LEGEND:

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
FGL	FINISHED GROUND LEVEL
	LEVEL
	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER DETAIL DWGS
	PLOT BOUNDARY
	FIRE TENDER ROUTE □ DIRECTION
	INGRESS/ EGRESS/ ENTRY/ EXIT
ROW	RIGHT OF WAY
	EMBANKMENT

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
ROAD LAYOUT - DIMENSION PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

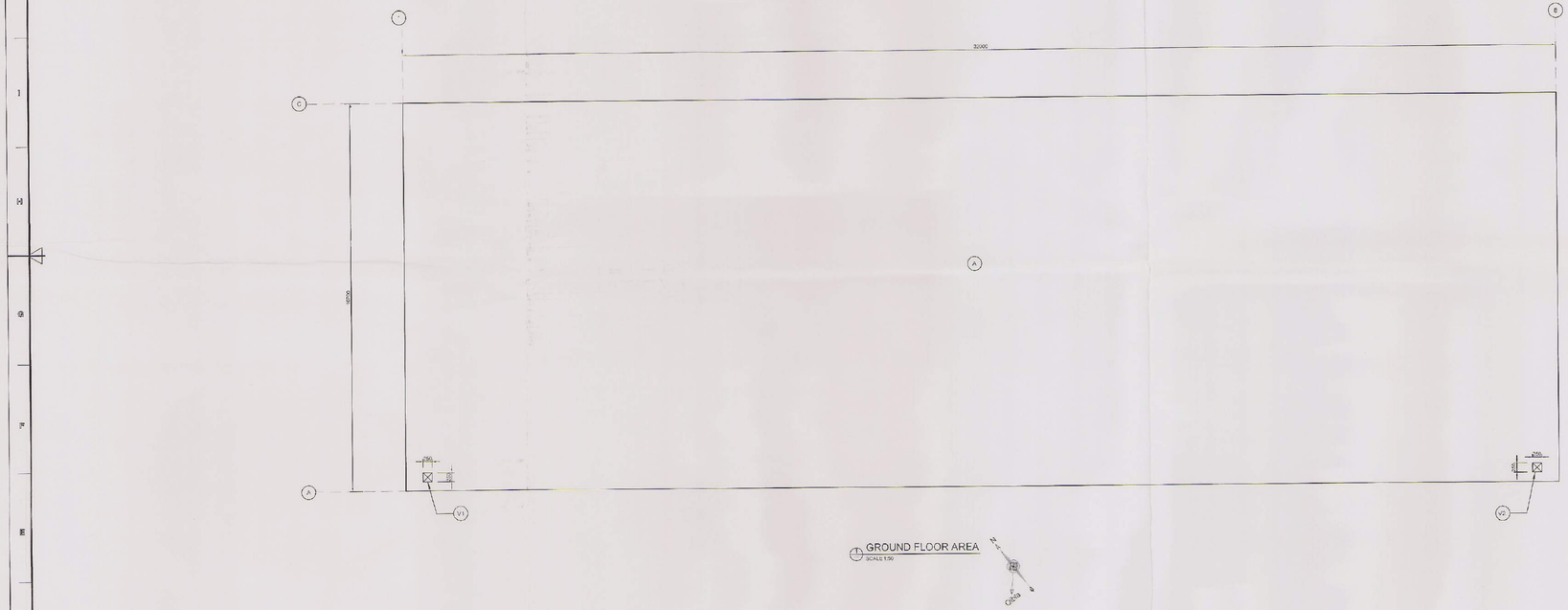
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81077

REV. C1



GROUND FLOOR AREA
SCALE 1:50

AREA CALCULATION CHART - GROUND FLOOR

COVERED AREA

NAME / TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM	
A	32000	16700	Length x Width	547.45
(a) TOTAL COVERED AREA				547.45

AREA OF VOIDS (Less than 1m²)

NAME / TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM	
V1	25C	200	Length x Width	0.062
V2	25C	200	Length x Width	0.062
(b) AREA OF VOIDS (Less than 1m²)				0.124

AREA OF VOIDS (More than or equal to 1m²)

NAME TAG	DIM. 1 (mm)	DIM. 2 (mm)	AREA IN SQM
-	-	-	-
(a) AREA OF VOIDS (More than or equal to 1m²)			-
TOTAL AREA OF VOIDS (a)+(b) = 0.124 + 0.00 =			0.124
TOTAL AREA = A - (b)+(a) 547.45 - 0.124 =			547.326

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EA	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
AREA CALCULATION
ARCHITECTURE - AUTHORITY SUBMITTAL

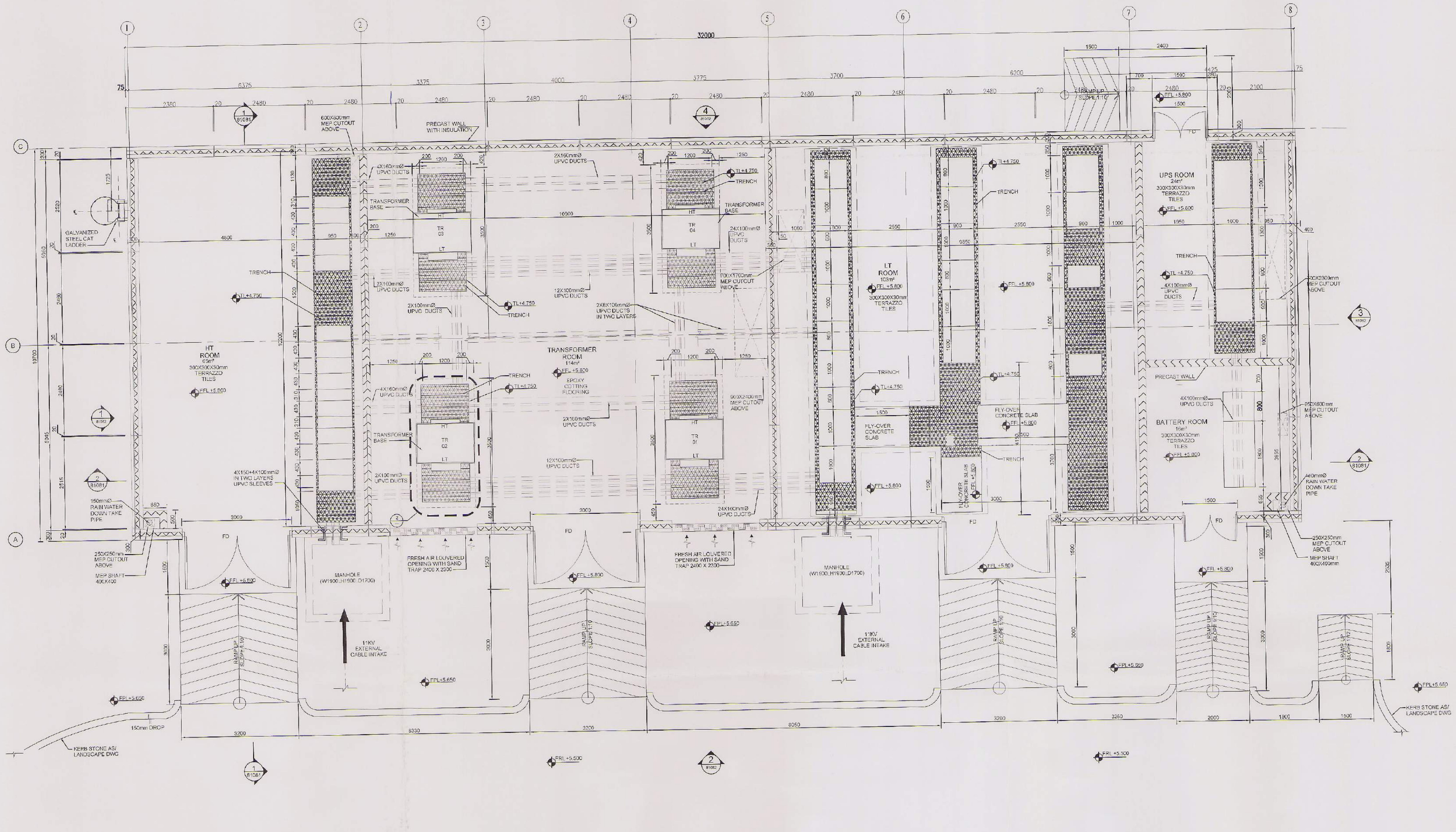
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJE	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

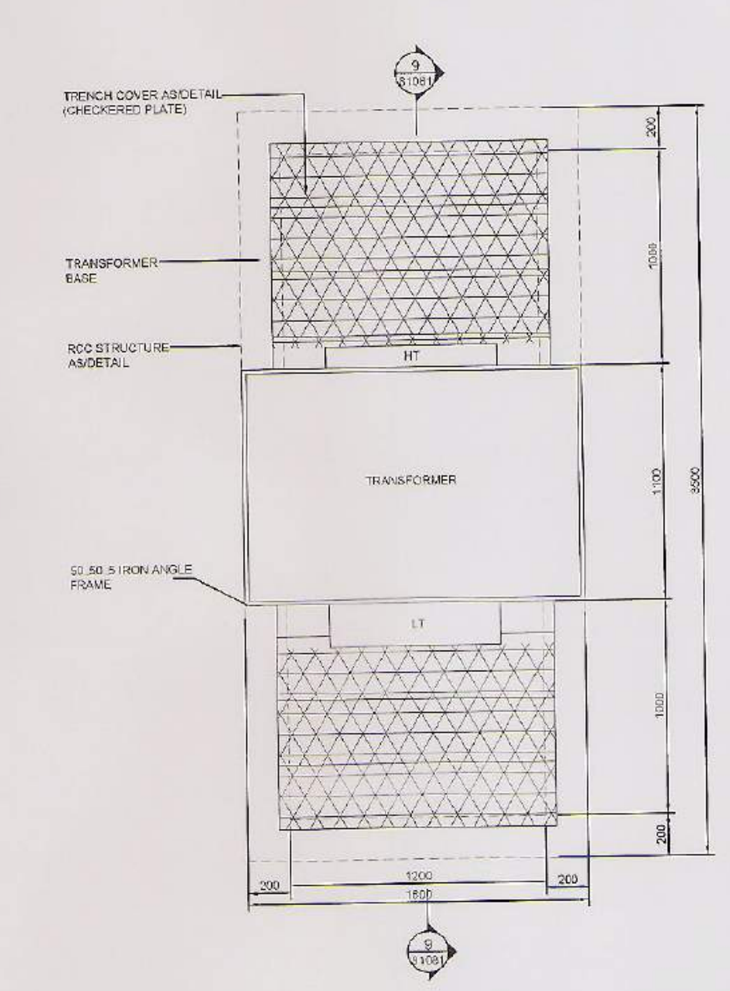
DRAWING NO.
RA140-32-BUI-AR-DW-81078

REV.
C1

A1(594X1189mm + 2mm)



GROUND FLOOR PLAN



TRANSFORMER BASE

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	SCREED
	RCC
	TRENCH COVER
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION (C1)
	FRESH AIR LOUVERED OPENING WITHSAND TRAP 2400X2300

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL BE 300mm AS PER MEW .THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS/ MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - GROUND FLOOR PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

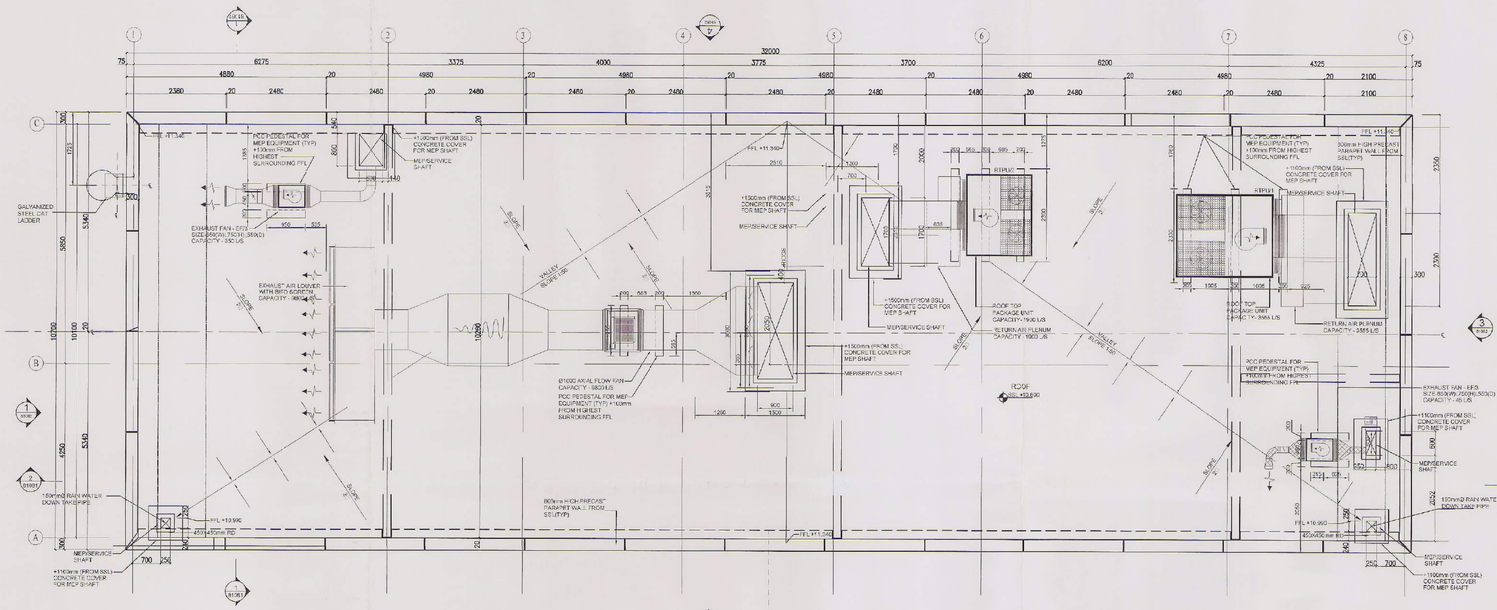
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED 02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81079

REV. C1



ROOF PLAN
SCALE 1:50

SYMBOL	DESCRIPTION
FFL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
℄	CENTER LINE
~	LEVEL DROP LINE

HATCH LEGEND

	FILLING AS / STRUCTURE
	SCREED
	ROC
	TRENCH COVER
	200mm PRECAST WALL
	300mm PRECAST WALL WITH INSULATION

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEHORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE IS ALL NOT BE MORE THAN 200mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRANCHES AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY. CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLVPB SHALL NOT EXCEED 30 METERS.
18. IT IS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISIONS WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BROWN.
20. ALL DOORS ARE STEEL DOORS AS PER REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECK	APPRO.
C1	02.07.17	FOR CONSTRUCTION.	EJI	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - ROOF PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

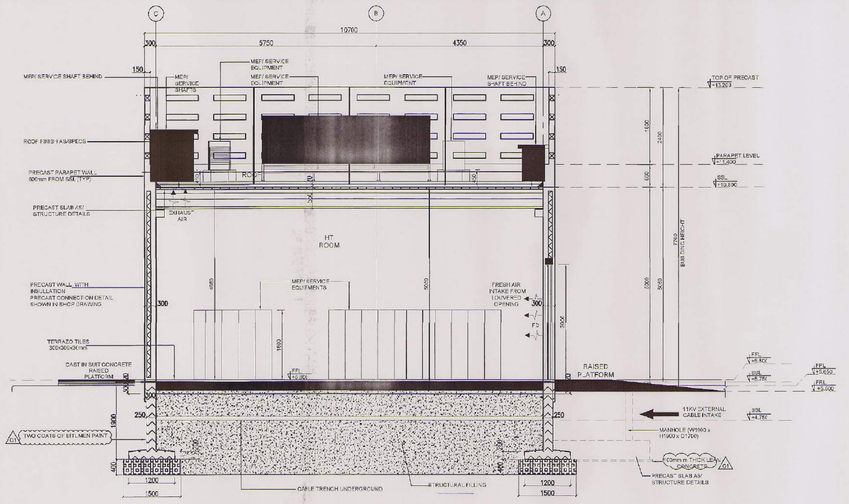
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJI	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02-07-17	02-07-17	02-07-17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

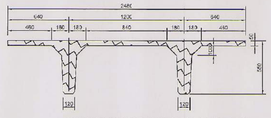
DRAWING NO.
RA140-32-BUI-AR-DW-81080

REV.
C1

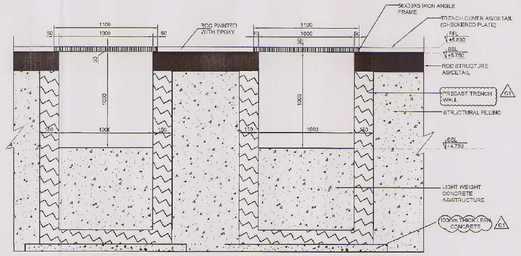
وزارة الكهرباء والماء
الإدارة المركزية لشبكات التوزيع الكهربائية
قسم الأعمال المدنية



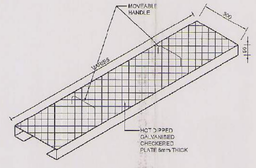
SECTION
SCALE 1:50



PRECAST DOUBLE TEE SLAB DETAIL
SCALE 1:50



TRANSFORMER ROOM TRENCH DETAIL
SCALE 1:50



TYPICAL TRENCH COVER DETAIL
SCALE NTS

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FSL	FINISH ROAD LEVEL
FFL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

HATCH LEGEND

	FILLING AS / STRUCTURE
	SCREED
	RCC
	300mm PRECAST WALL WITH INSULATION
	200mm PRECAST WALL
	TRENCH COVER
	BLOCK WORK
	ROOTOP MIX
	LEAN CONCRETE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE TO BE RATED FOR 2HOURS AS PER K.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING MAKE AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 750mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEERS FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS EMDAN SHALL BE OF MEW AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER K.F.D REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING PERIPHERAL ALL SLEEVES BETWEEN HT AND TRANSFORMER, LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
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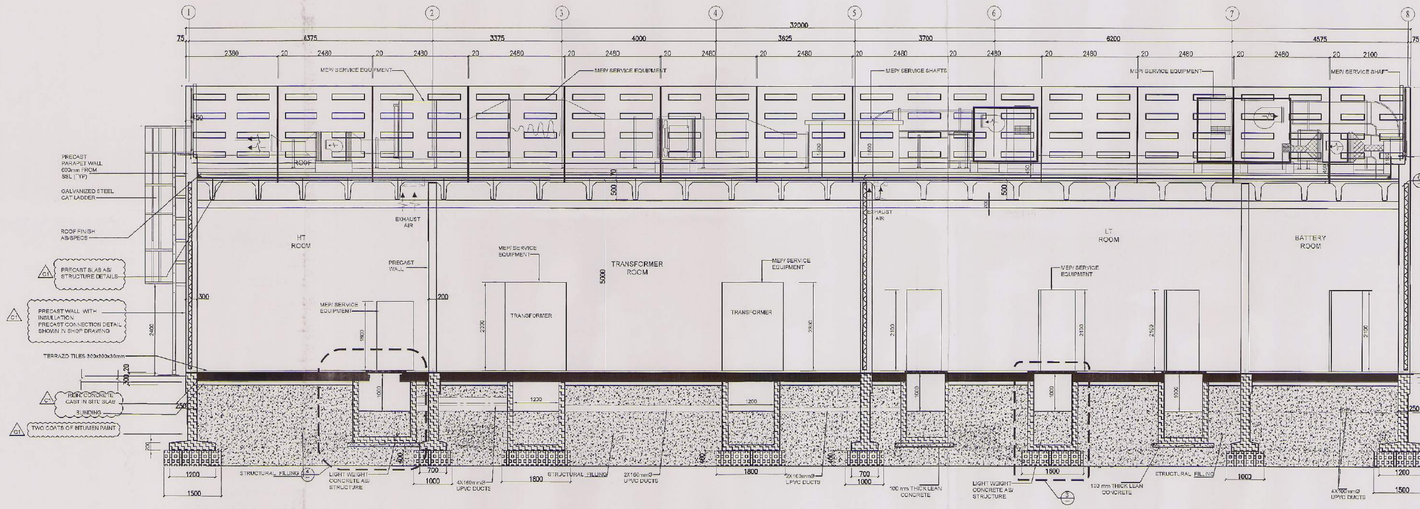
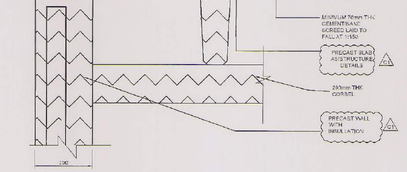
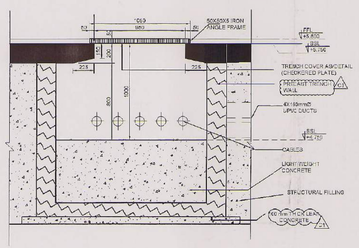
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO VIP'S SHALL NOT EXCEED 20 METERS.
18. IT IS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISION WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS PER REQUIREMENT.
21. AN ANTI-BIRD INLET SHOULD HAVE DUST FILTER PROTECTION.



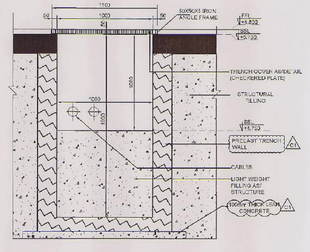
SECTION
SCALE 1:50



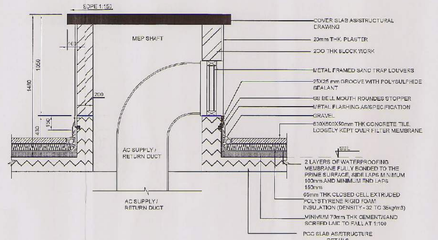
TYPICAL SLAB DETAIL
SCALE 1:50



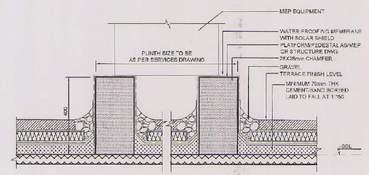
TYPICAL 11KV TRENCH DETAILS
SCALE 1:20



TYPICAL TRENCH DETAIL
SCALE 1:20



SLAB CUTOUT ENCLOSURE DETAIL
SCALE 1:20



TYP PLINTH DETAIL @TERRACE LEVEL FOR SERVICE EQUIPMENT
SCALE 1:20

C	02-07-17	FOR CONSTRUCTION	EJL	NSH	SCP
REV	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - SECTIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

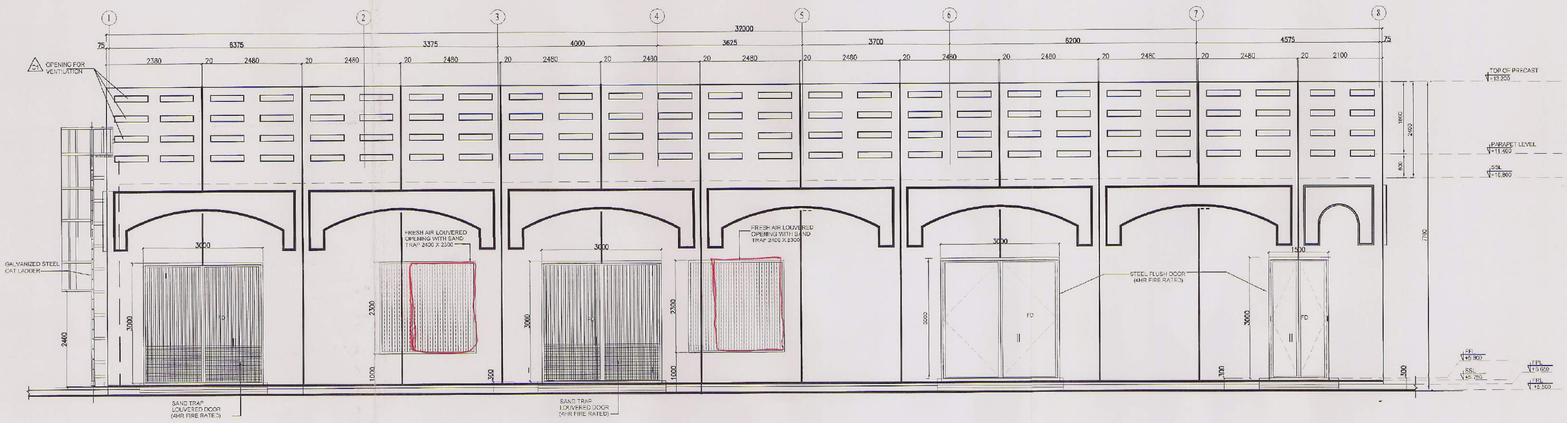
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	NSH	SCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

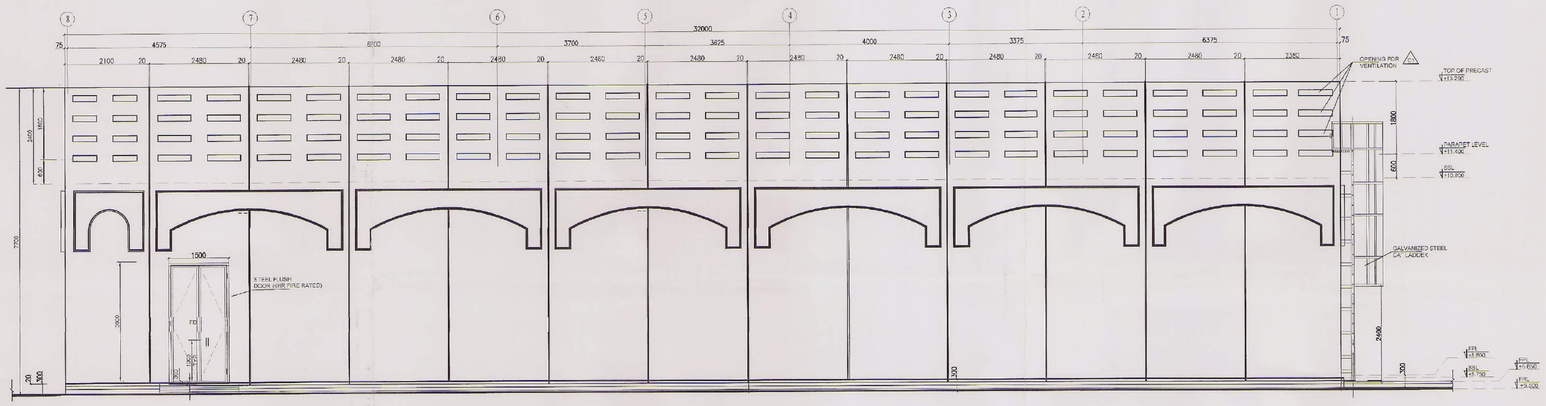
DRAWING NO.
RA140-32-BUI-AR-DW-81081

REV.
C1

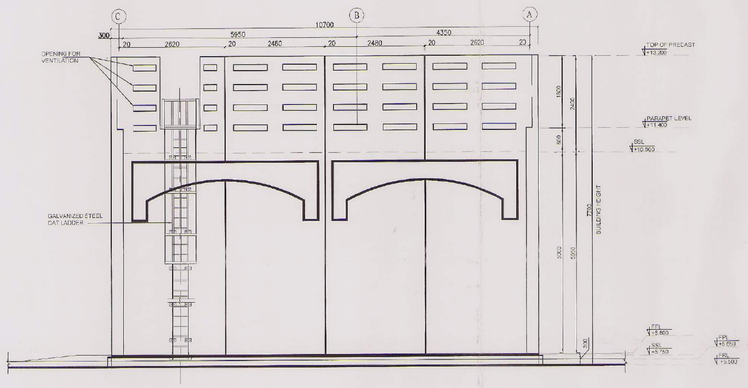
وزارة الكهرباء والماء
إدارة تنفيذ المشاريع الكهربائية
قسم الأعمال المدنية



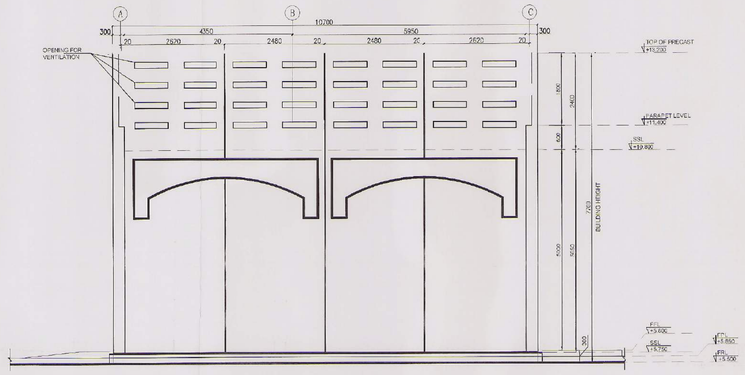
1 ELEVATION
SCALE - 1:50



3 ELEVATION
SCALE - 1:50



2 ELEVATION
SCALE - 1:50



4 ELEVATION
SCALE - 1:50

SYMBOL LEGEND

SYMBOL	DESCRIPTION
FGL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
	LEVEL
	CENTER LINE
	LEVEL DROP LINE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. HT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER K.P.O. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KPO APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHEQUERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHEQUERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO M.E.W. APPROVAL/ STANDARD THICKNESS OF THE PLATE SHALL BE 6mm. CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS (KNOWN & ALL) BE OF LEVEL AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE. AS PER KPO REQUIREMENT.
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO MAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS FOR FIXING SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLPS SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO ADJUST ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISION WALL SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS MEP REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.
22. ALL WALLS ARE INSULATED.

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
01	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

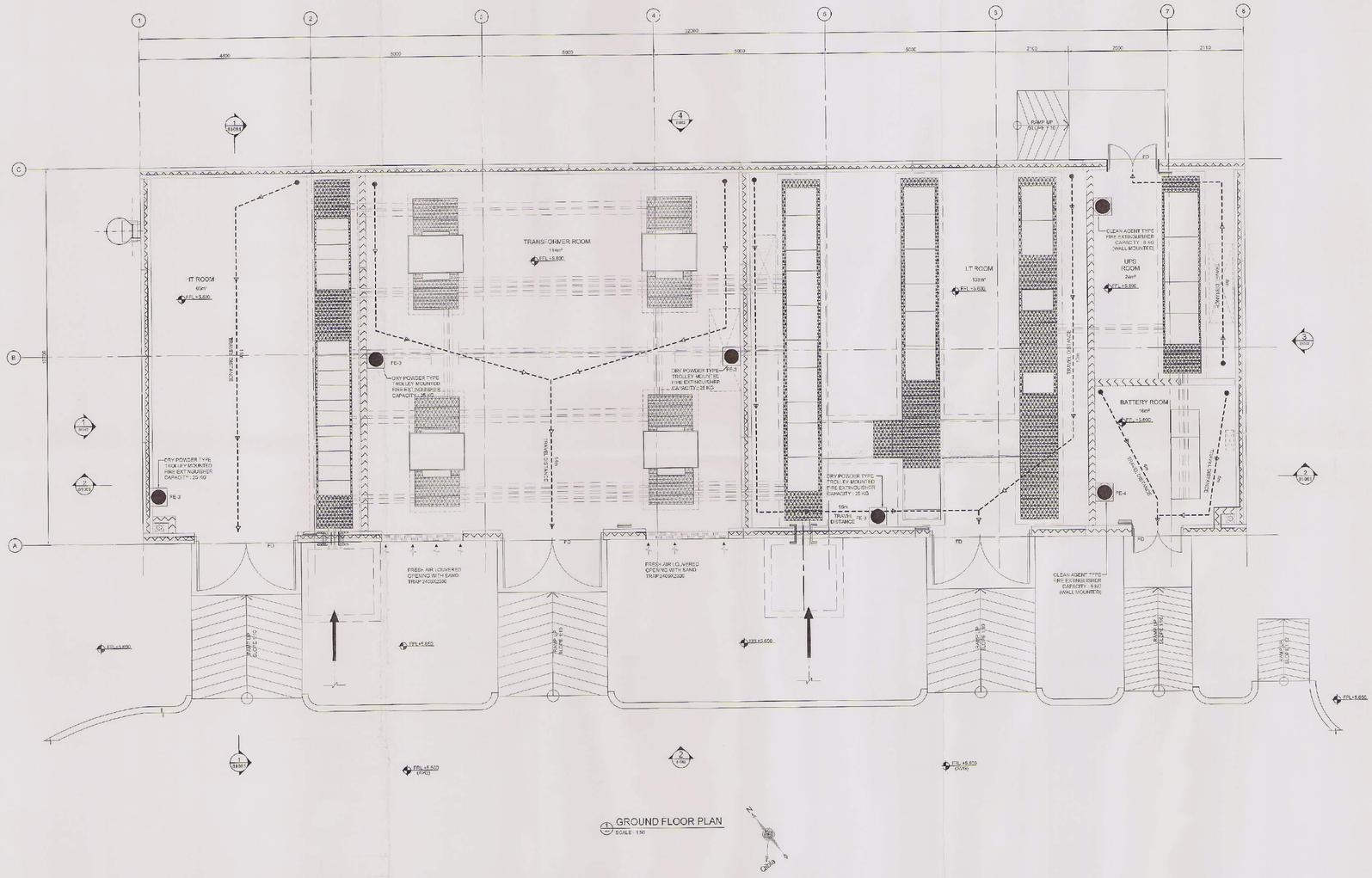
PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
GENERAL ARRANGEMENT - ELEVATIONS
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81082
REV. C1



GROUND FLOOR PLAN
SCALE : 1:50

SHEETS NOTES

1. ALL TRAVEL DISTANCES ARE MEASURED FROM THE DOOR OF ANY ROOM TO THE FINAL POINT OF EXIT.
2. ALL TRAVEL DISTANCES SHALL BE LESS THAN OR EQUAL TO 30M.
3. THE MAXIMUM TRAVEL DISTANCE FROM THE FARTHEST POINT INSIDE THE ROOM TILL ITS EXIT DOOR SHALL NOT BE MORE THAN 15M
4. THE MAXIMUM DEAD END DISTANCE SHALL NOT BE MORE THAN 7.5M

LEGEND

EGRESS ROUTE / TRAVEL DISTANCE	
START POINT	
FIRE DOOR	
FRL FINISH ROAD LEVEL	
FPL FINISH PAVEMENT LEVEL	
FFL FINISH FLOOR LEVEL	
SSL STRUCTURAL SLAB LEVEL	
FGL FINISHED GROUND LEVEL	
LEVEL	
CENTRE LINE	
EMERGENCY EXIT LIGHT	
FIRE EXTINGUISHER	

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2. UPS, BATTERY AND LT ROOMS HAVE TO BE AIR-CONDITIONED. LT ROOM AND TRANSFORMER ROOM SHALL ONLY BE VENTILATED.
3. ALL DOORS OF HT ROOM, LT ROOM AND TRANSFORMER ROOM ARE FIRE RATED FOR 2HOURS AS PER H.F.D. REQUIREMENT.
4. ALL CABLE DUCTS SHALL BE CLOSED WITH RUBBER PLUGS BEFORE INSTALLATION OF CABLES BY M.E.W.
5. INTERIOR LIGHTS ARE FLUORESCENT AND WALL AND CEILING MOUNTED.
6. SIGN INDICATING NAME AND NUMBER OF SUBSTATION WILL BE FIXED ABOVE THE DOOR AS PER M.E.W. REQUIREMENT.
7. THE SUB-STATION SHALL BE PROVIDED WITH ALTERNATE TO HALON PROTECTION SUBJECT TO KFD APPROVAL.
8. ALL TRENCHES SHALL BE COVERED WITH CHECKERED PLATES BEFORE INSTALLATION OF HT EQUIPMENT. MAXIMUM WIDTH OF THE CHECKERED PLATE SHALL NOT BE MORE THAN 250mm WIDE SUBJECT TO MEW APPROVAL. STANDARD THICKNESS OF THE PLATE SHALL BE 6mm.CONTRACTOR TO PROVIDE COMPLETE LAYOUT SHOP DRAWING.
9. AS PART OF THIS CONTRACT, THE CONTRACTOR SHALL CO-ORDINATE WITH M.E.W. ENGINEER FOR EXECUTION OF TOTAL SUB-STATION WORK IN ALL RESPECTS.
10. SHOP DRAWINGS SHOULD BE FULLY COORDINATED WITH CIVIL AND ARCHITECTURAL TRADES AND APPROVED BEFORE STARTING THE CONCRETE WORK.
11. ALL SLEEVES AND DUCTS SHOWN SHALL BE OF UPVC AND IN COMPLIANCE WITH M.E.W. STANDARD.
12. SUFFICIENT OPENINGS SHOULD BE KEPT IN THE TRENCH COVER FOR INGRESS OF THE ALTERNATE TO HALON INTO THE TRENCH AND EGRESS OF SMOKE FROM THE TRENCH IN CASE OF FIRE (AS PER KFD REQUIREMENT)
13. FIRE RESISTING CAULKING COMPOUND SHALL BE USED FOR SEALING INSIDE ALL SLEEVES BETWEEN HT AND TRANSFORMER LT AND TRANSFORMER ROOMS AFTER INSTALLATION.
14. AFTER INSTALLATION OF CABLES ALL DUCTS INCLUDING THE SPARE DUCTS SHALL BE SEALED WITH FIRE RESISTANT MATERIAL MENTIONED ABOVE.
15. PROVIDE HASP AND BOLTS AS REQUIRED FOR PADLOCKING FACILITY, CO-ORDINATE WITH M.E.W. FOR SIZE OF HASP AND BOLTS.
16. CONTRACTOR TO TAKE NECESSARY PRECAUTIONS AND PROVIDE SUPPORTS TO FIX END SLEEVES/PIPES AT EXTERNAL WALL PENETRATIONS.
17. MAXIMUM LENGTH OF THE LT CABLE FROM TRANSFORMER TO MLTP'S SHALL NOT EXCEED 20 METERS.
18. ITS CONTRACTOR'S RESPONSIBILITY TO VALUE ROOF FINISH LEVELS AT THE TIME OF CONSTRUCTION. ALL ROOF FINISH LEVELS HAS BEEN ASSUMED.
19. ALL INTERIOR SUB DIVISION WALLS SHALL BE FINISHED WITH SAND CEMENT PLASTER PAINTED IN WHITE COLOR AND DOORS SHALL BE PAINTED GREY OR BEIGE.
20. ALL DOORS ARE STEEL DOORS AS M&P REQUIREMENT.
21. AIR VENTILATION INLET SHOULD HAVE DUST FILTER PROTECTION.

وزارة الكهرباء والماء
إدارة شبكات التوزيع الكهربائية
قسم الأعمال الهندسية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHKD.	APPRD.
C1	02-07-17	FOR CONSTRUCTION	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

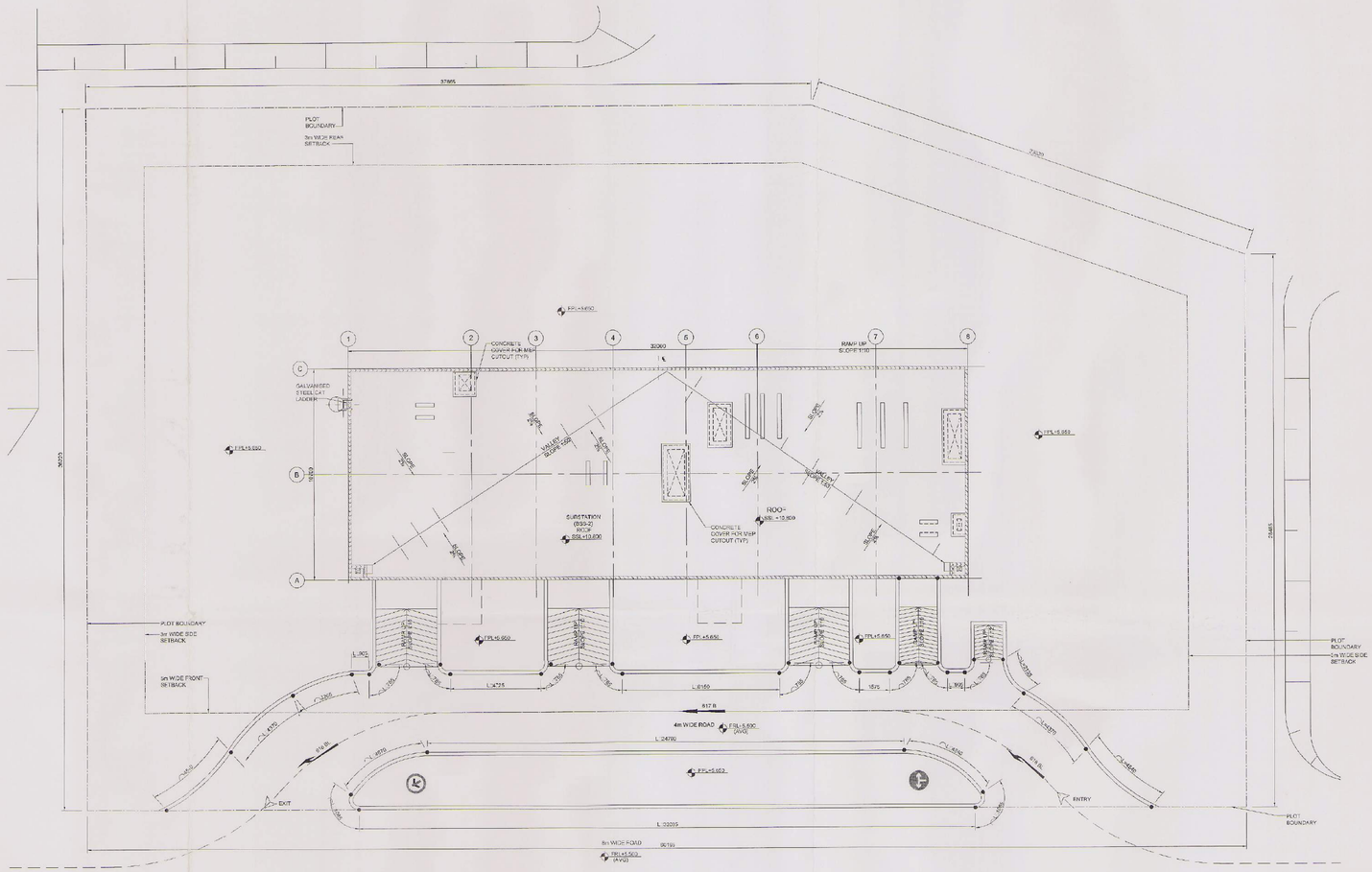
DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
LIFE SAFETY - PLAN
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	EJL	JSK	HSH	BCP
DATE ISSUE				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

DRAWING NO.
RA140-32-BUI-AR-DW-81083

REV.
C1



1 ROAD LAYOUT(TRAFFIC MARKINGS) & SUBSTATION (BSS-2)
SCALE 1:100

TYPICAL SIGNAGE LEGEND

	617 B ROAD SIGN
	618 BL ROAD SIGN
SIGN 560R	"TURNING RESTRICTED"
SIGN 411	"TURNING RESTRICTED"
SIGN 411	ROAD SIGN

SHEET NOTES:

1. THE FINISHED GROUND FLOOR LEVEL OF ALL THE PROCESS BUILDINGS IS +0.000m FROM AMSL.
2. ALL FINISH ROAD LEVEL (FRL) IS FROM AMSL.
3. THE PLINTH LEVEL OF THE PROCESS BUILDINGS IS +0.300m HIGHER FROM THE FINISHED ROAD LEVEL ADJACENT TO THE BUILDING.
4. ALL DIMENSIONS ARE IN (L) METERS & ALL LEVELS ARE IN METERS.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, PLUMBING, FIRE FIGHTING, AIR-CONDITIONING & STRUCTURE DRAWINGS & ROAD & EMBANKMENT DRAWINGS.
6. FOR ROADS MARKING REFER TO KUWAIT TRAFFIC MANUAL.

LEGEND:

SYMBOL	DESCRIPTION
FRL	FINISH ROAD LEVEL
FPL	FINISH PAVEMENT LEVEL
FFL	FINISH FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
FGL	FINISHED GROUND LEVEL
	LEVEL
℄	CENTER LINE
	VEHICULAR TRAFFIC MOVEMENT
	HANDICAP PARKING
	SETBACK LINE
	METAL CHAIN LINK FENCE FOR SITE BOUNDARY (TYP) REFER DETAIL DWGS
	PLOT BOUNDARY
	FIRE TENDER ROUTE & DIRECTION
	INGRESS/ EGRESS/ ENTRY/ EXIT
ROW	RIGHT OF WAY
	EMBANKMENT

وزارة الكهرباء والماء
وادارة شبكات التوزيع الكهربائية
قسم الاعمال المدنية

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	10-07-17	FOR CONSTRUCTION	E.A.	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/14C

DRAWING TITLE
PERMANENT BUILDINGS
SOUTH ISLAND - SUBSTATION 11kv (BSS-2)
ROAD LAYOUT - TRAFFIC MARKINGS
ARCHITECTURE - AUTHORITY SUBMITTAL

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	E.A.	JSK	HSH	BCP
DATE ISSUED				
02-07-17	02-07-17	02-07-17	02-07-17	02-07-17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION | Combined Group Contracting Company

DRAWING NO. RA140-32-BUI-AR-DW-81084 REV. C1

STATE OF KUWAIT

MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

ADMINISTRATION & FACILITY BUILDINGS - STRUCTURE
SUBSTATION BSS-2 (SOUTH ISLAND)- DRAWINGS PACKAGE

Drawing package No.: RA140-32-BUI-CW-DW-65655-C1

Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-CW-DW-65656	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	ELECTRICAL PLAN FOOTING & TRENCHES	
RA140-32-BUI-CW-DW-65657-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65657-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65657-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65657-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65657-5	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65657-6	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	FOOTING UNIT DETAILS	
RA140-32-BUI-CW-DW-65658	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	RCC TIE BEAM DETAILS	
RA140-32-BUI-CW-DW-65659	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	ERECTION PLAN DT & SECTION A-A	
RA140-32-BUI-CW-DW-65660-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	ELEVATION	
RA140-32-BUI-CW-DW-65660-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	ELEVATION	
RA140-32-BUI-CW-DW-65661-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-5	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-6	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project

Main Link – Contract RA/140

ADMINISTRATION & FACILITY BUILDINGS - STRUCTURE
SUBSTATION BSS-2 (SOUTH ISLAND)- DRAWINGS PACKAGE

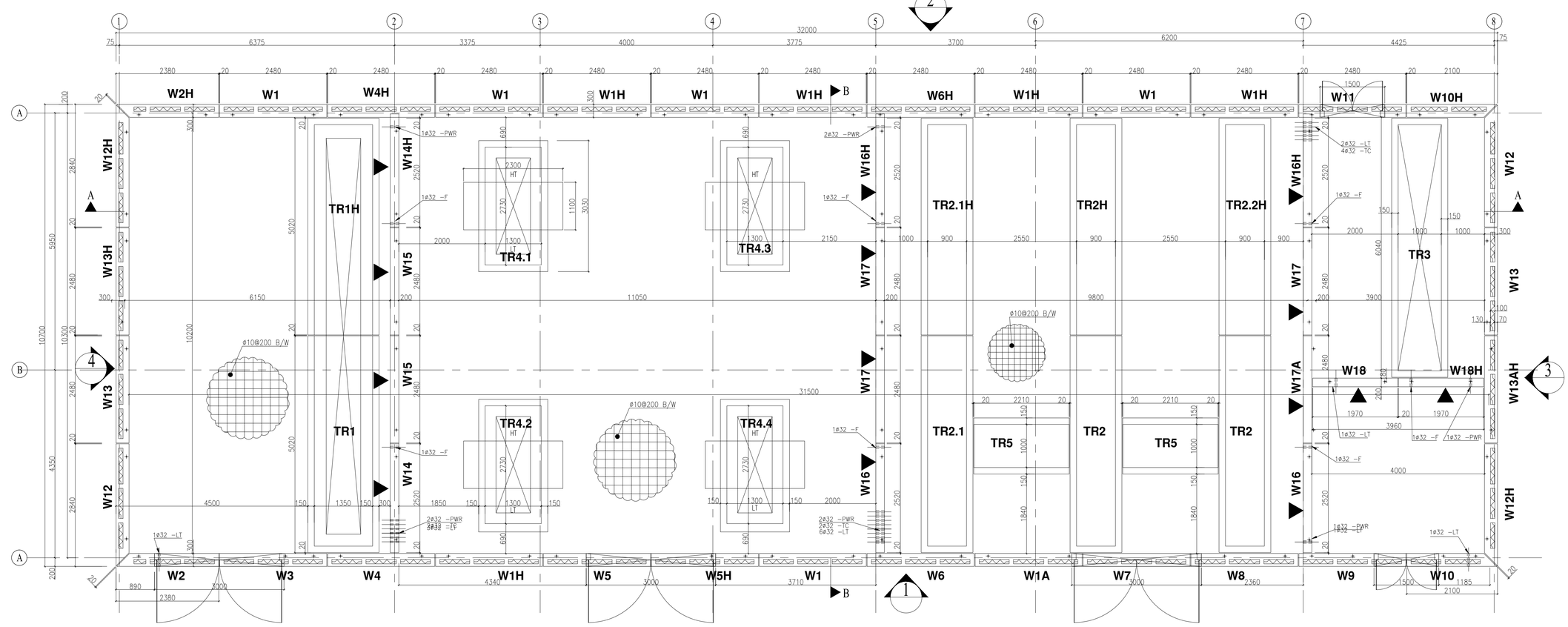
Drawing package No.: RA140-32-BUI-CW-DW-65655-C1

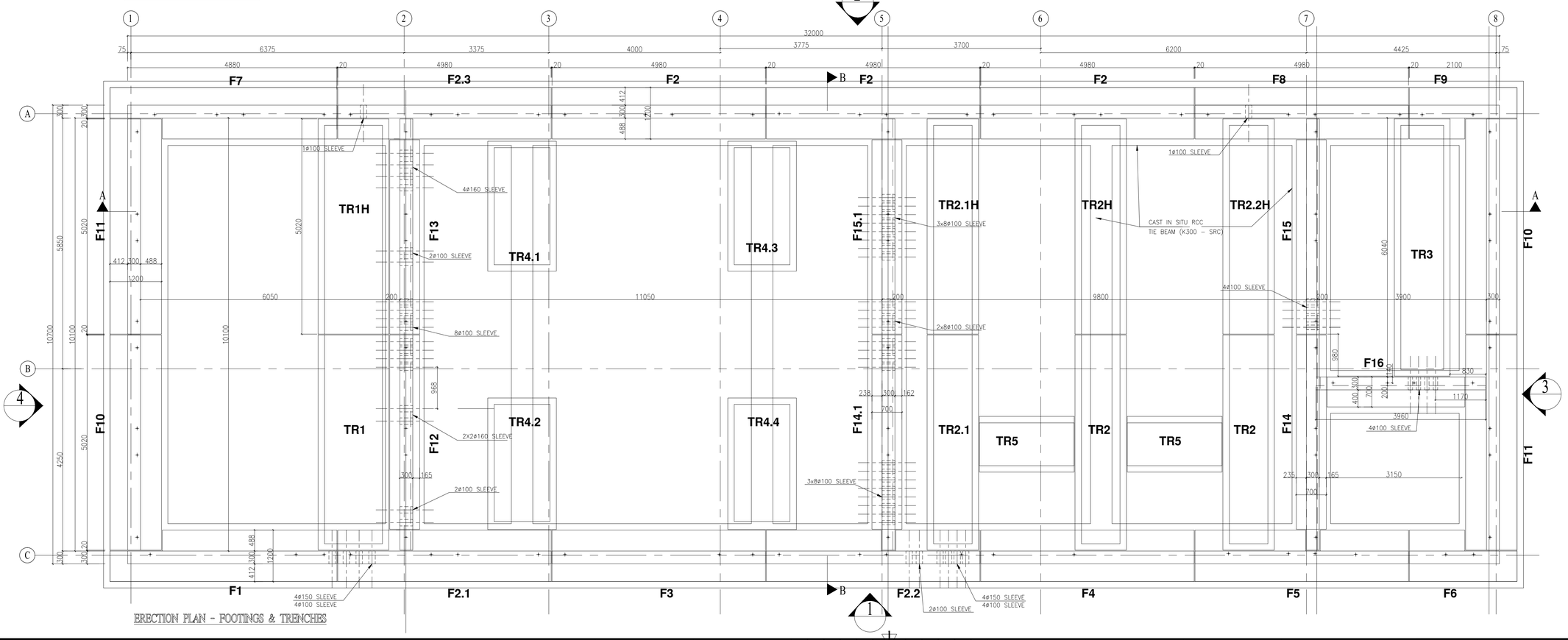
Code	Revision	Date	Title 1	Title 2	Title 3	Title 4	Comment
RA140-32-BUI-CW-DW-65661-7	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-8	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-9	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-10	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-11	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-12	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-13	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65661-14	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	WALL UNIT DETAIL	
RA140-32-BUI-CW-DW-65662	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	STRUCTURAL TOPPING CONCRETE	
RA140-32-BUI-CW-DW-65663-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	DT UNIT DETAIL	
RA140-32-BUI-CW-DW-65663-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	DT UNIT DETAIL	
RA140-32-BUI-CW-DW-65664-1	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65664-2	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65664-3	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65664-4	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	SOUTH ISLAND	SUBSTATION (BSS-2)	TRENCH UNIT DETAIL	
RA140-32-BUI-CW-DW-65665	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	ERECTION PLAN FOOTING & TRENCHES	
RA140-32-BUI-CW-DW-65666	C1	02/07/17	ADMIN & FACILITY BUILDING - STRUCTURE	NORTH ISLAND	SUBSTATION (BSS-1)	TYPICAL DETAILS	

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.

ERECTION PLAN - TRENCHESS





ERECTION PLAN - FOOTINGS & TRENCHES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
ERECTION PLAN FOOTING & TRENCHES

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

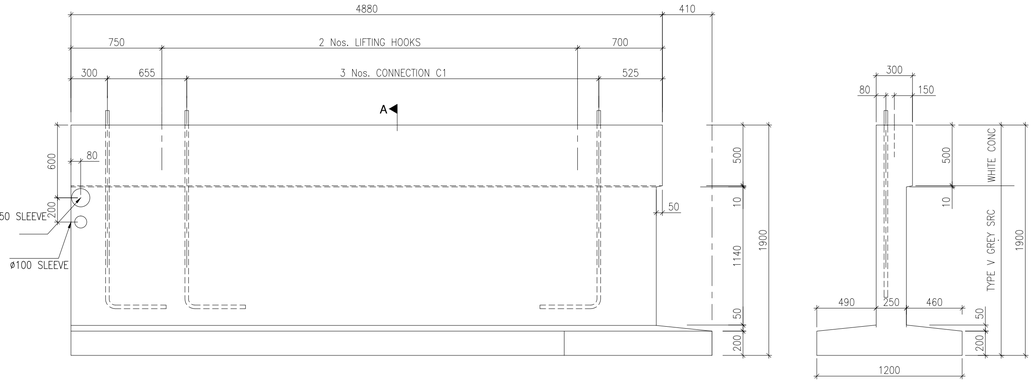
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.23260054, FAX .23260067.

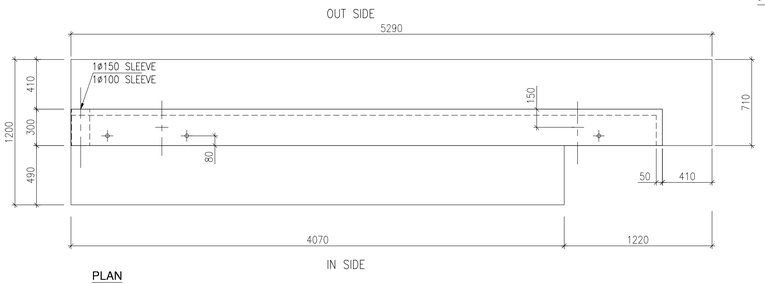
DRAWING NO.	REV.
RA140-32-BUI-CW-DW-65656	C1

A0(841X1189mm +2mm)

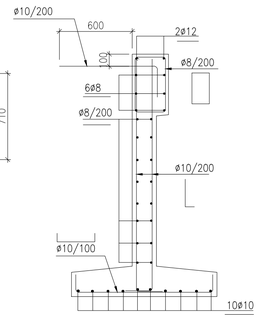


ELEVATION

SECTION-A



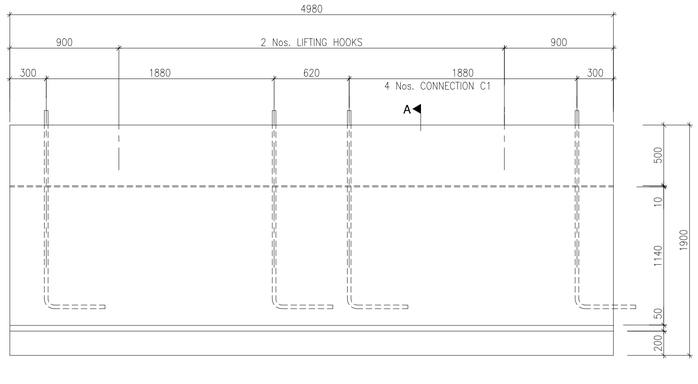
PLAN



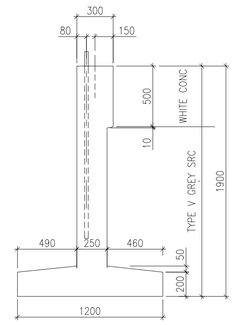
SECTION-A
SHOWING REINF.

FOOTING - F1

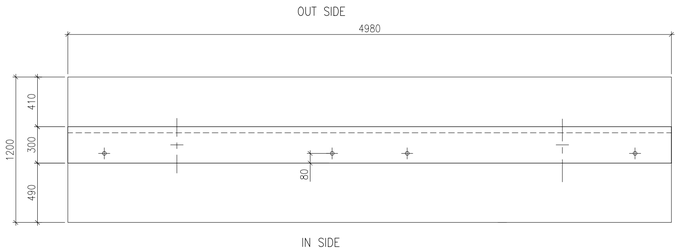
Nos. REQD. = 1 VOLUME 3.69 m³



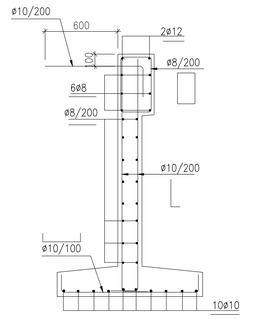
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F2

Nos. REQD. = 3 VOLUME 3.68 m³

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

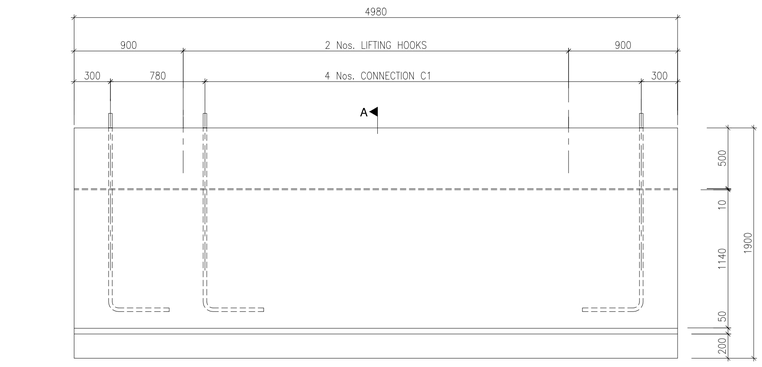
SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

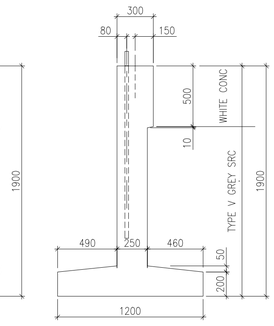
CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

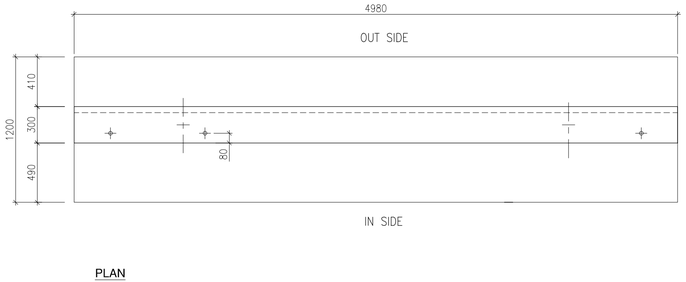
COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK



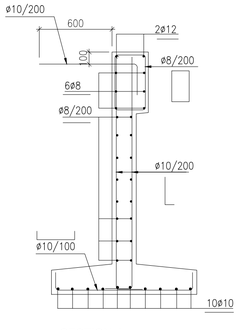
ELEVATION



SECTION-A



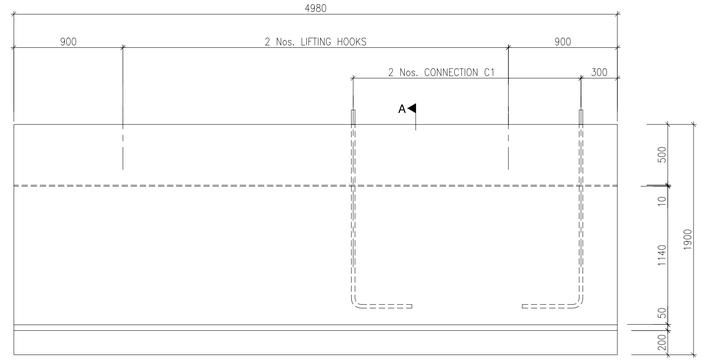
PLAN



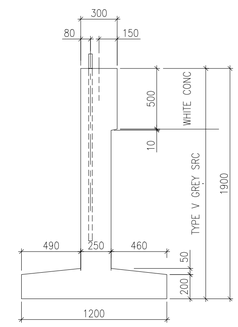
SECTION-A
SHOWING REINF.

FOOTING - F3

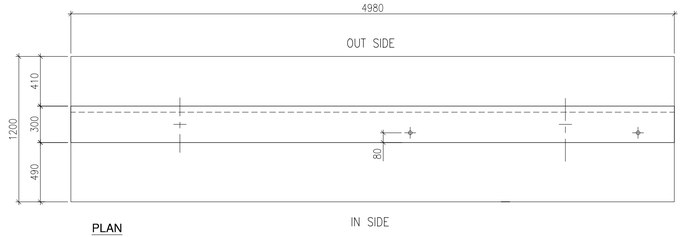
Nos. REQD. = 1 VOLUME 3.68 m³



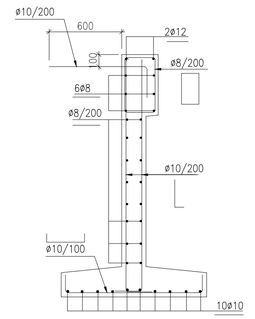
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F4

Nos. REQD. = 1 VOLUME 3.68 m³

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

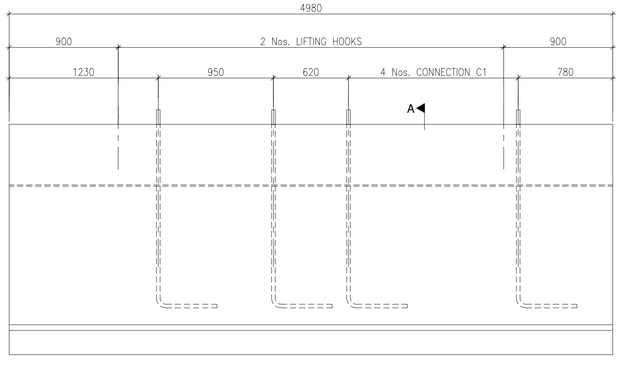
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

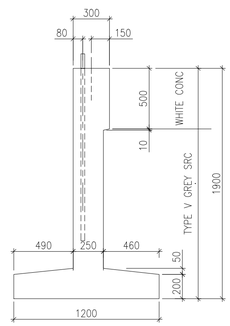
DRAWING NO. RA140-32-BUI-CW-DW-65657-1

REV. C1

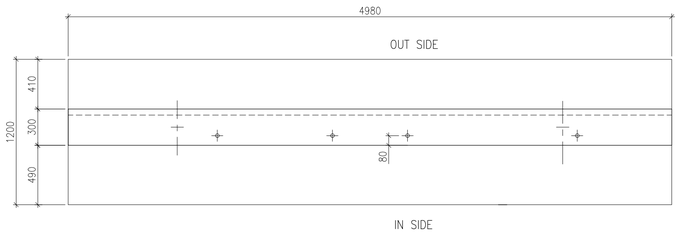
A0(841x1189mm +20mm)



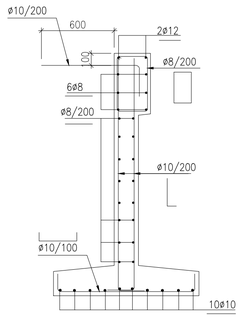
ELEVATION



SECTION-A



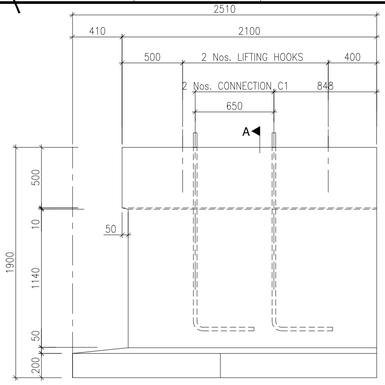
PLAN



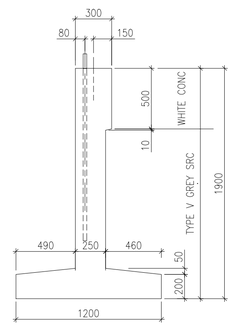
SECTION-A
SHOWING REINF.

FOOTING - F5

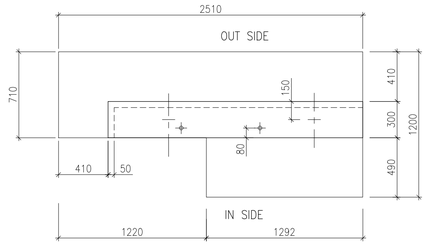
Nos. REQD. = 1 VOLUME 3.68 m³



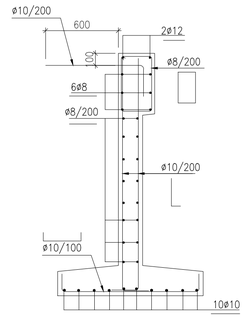
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F6

Nos. REQD. = 1 VOLUME 1.60 m³

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

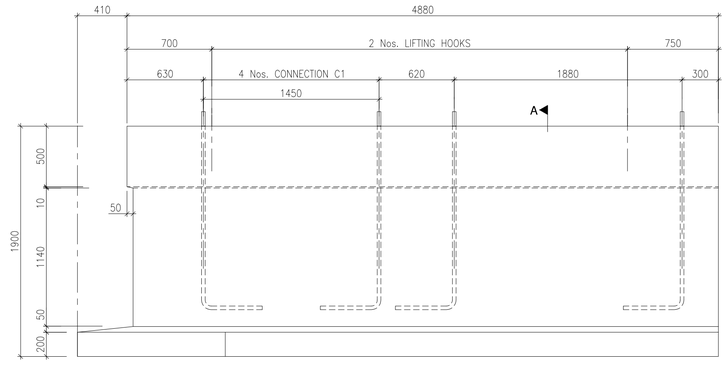
SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

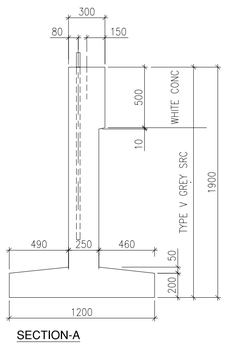
CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

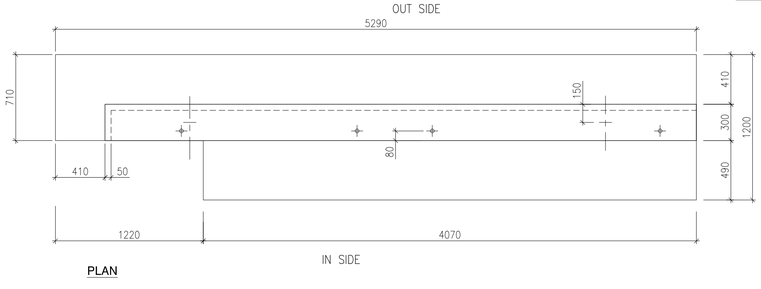
COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK



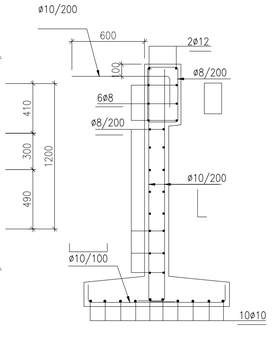
ELEVATION



SECTION-A



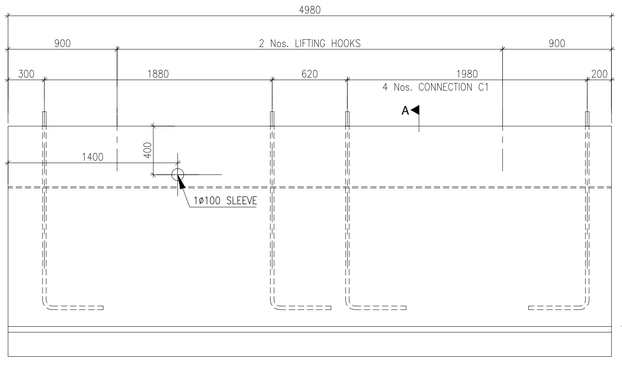
PLAN



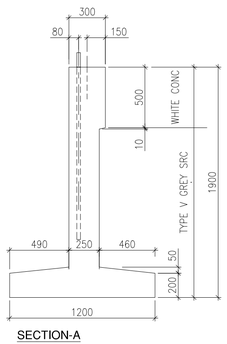
SECTION-A
SHOWING REINF.

FOOTING - F7

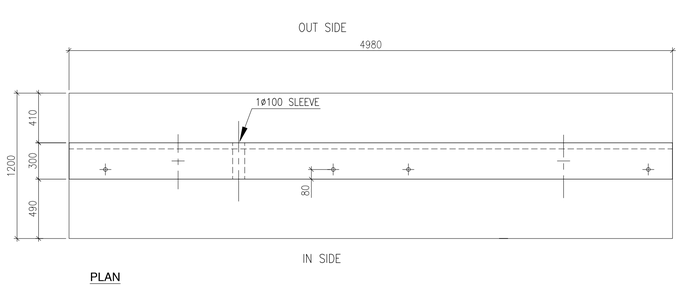
Nos. REQD. = 1 VOLUME 3.69 m³



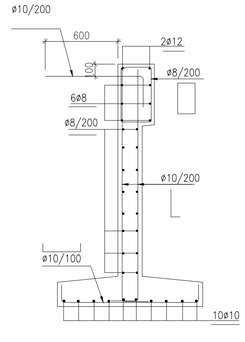
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F8

Nos. REQD. = 1 VOLUME 3.68 m³

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

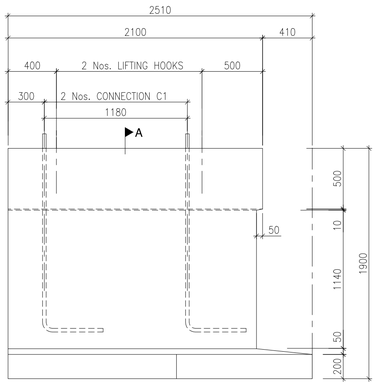
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

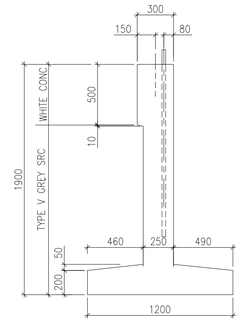
DRAWING NO. RA140-32-BUI-CW-DW-65657-2

REV. C1

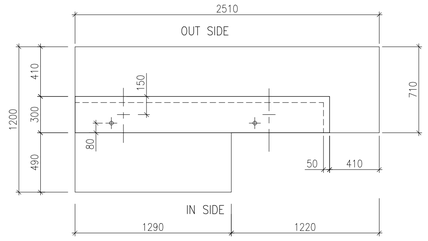
A0(841X1189mm 42mm)



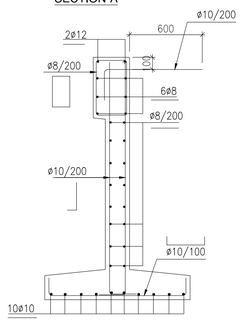
ELEVATION



SECTION-A



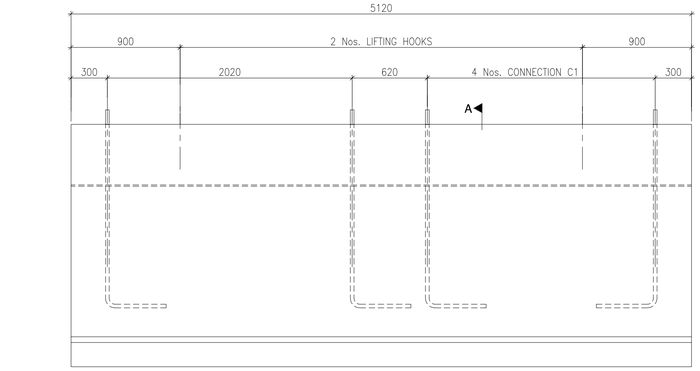
PLAN



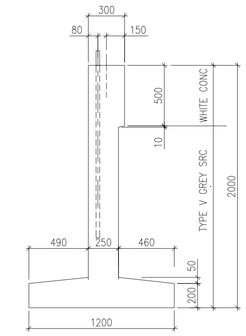
SECTION-A
SHOWING REINF.

FOOTING - F9

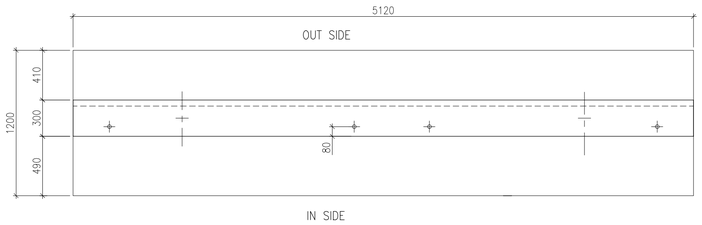
Nos. REQD. = 1 VOLUME 1.60 m³



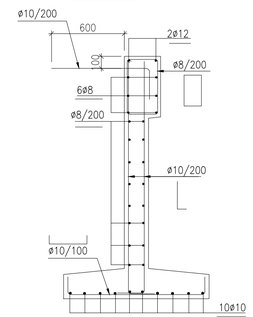
ELEVATION



SECTION-A



PLAN



SECTION-A
SHOWING REINF.

FOOTING - F10

Nos. REQD. = 2 VOLUME 3.78 m³

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

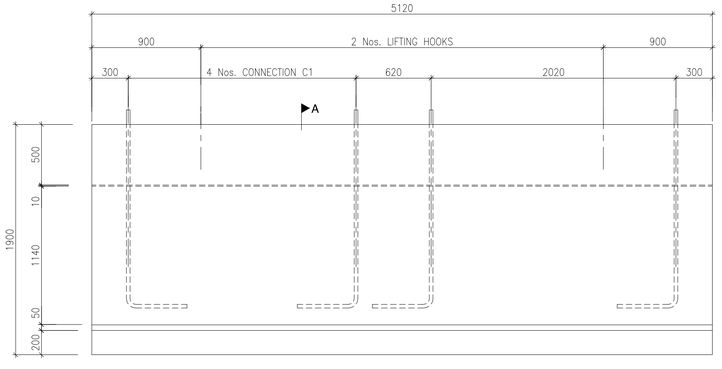
SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

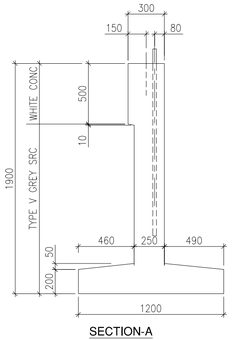
CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

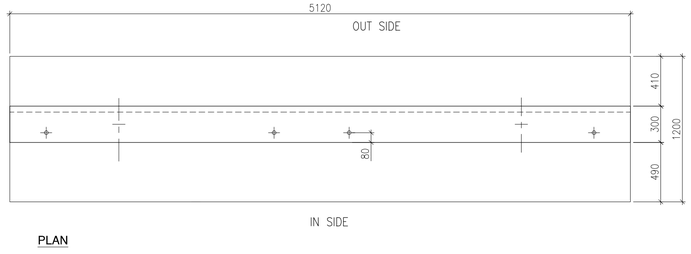
COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK



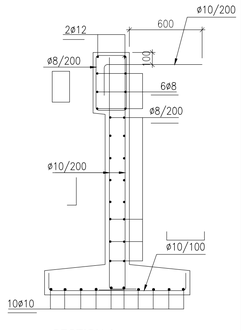
ELEVATION



SECTION-A



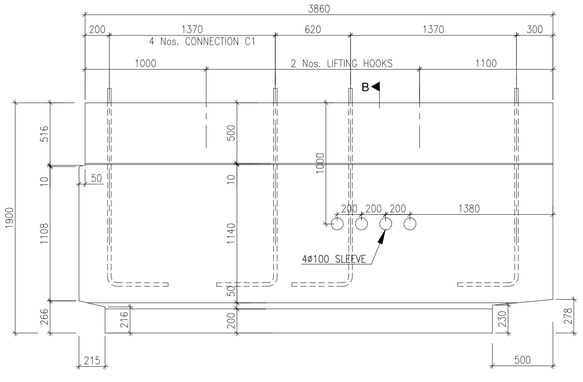
PLAN



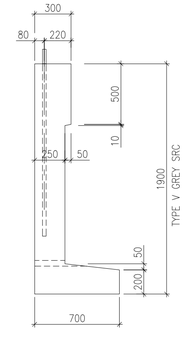
SECTION-A
SHOWING REINF.

FOOTING - F11

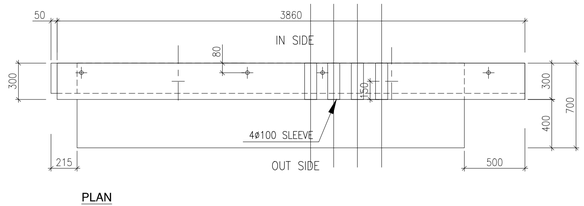
Nos. REQD. = 2 VOLUME 3.78 m³



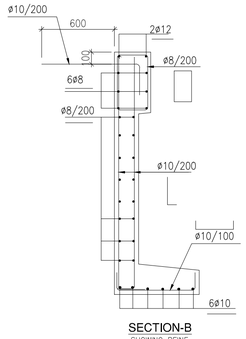
ELEVATION



SECTION-B



PLAN



SECTION-B
SHOWING REINF.

FOOTING - F16

Nos. REQD. = 1 VOLUME 2.40 m³

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

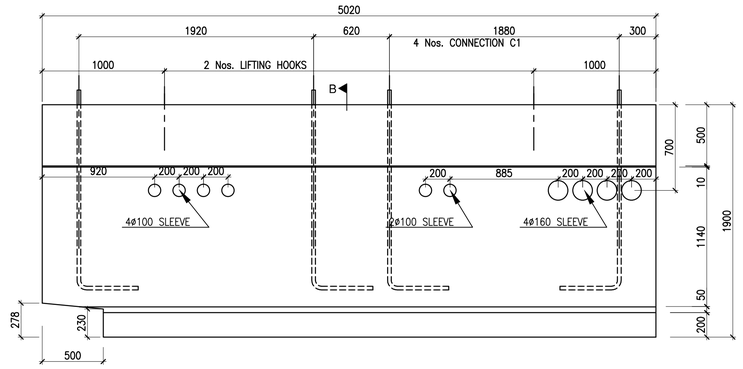
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

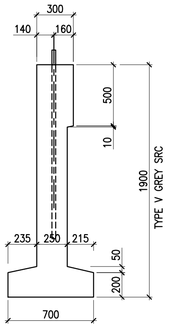
DRAWING NO. RA140-32-BUI-CW-DW-65657-3

REV. C1

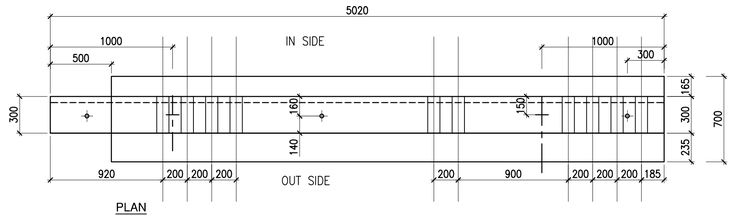
A0(841X1189mm 12mm)



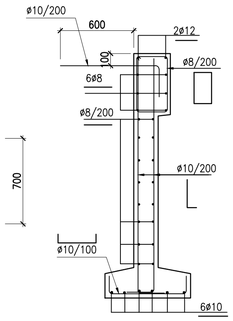
ELEVATION



SECTION-C



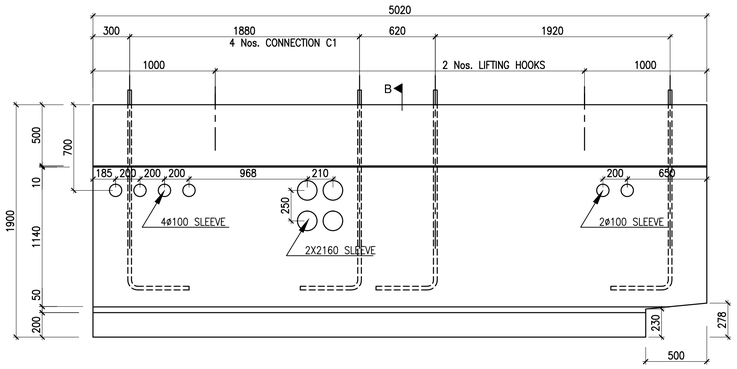
PLAN



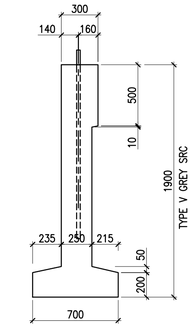
SECTION-C
SHOWING REINF.

FOOTING - F13

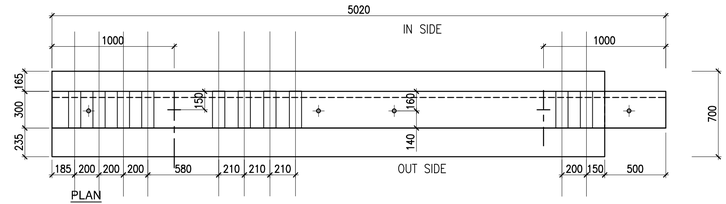
Nos. REQD. = 1 VOLUME 3.20 m³



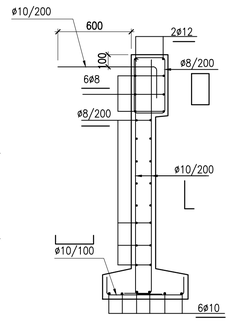
ELEVATION



SECTION-C



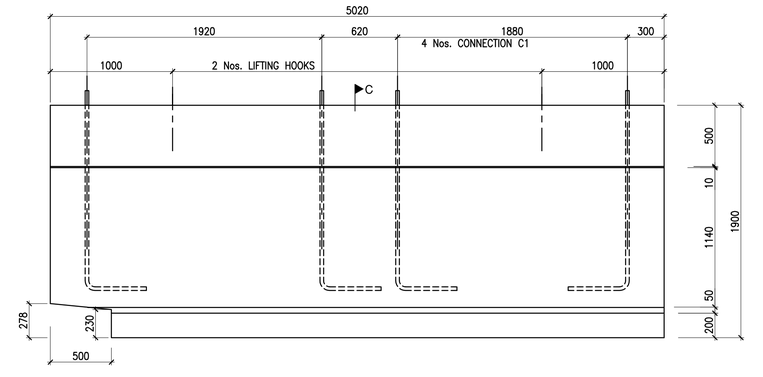
PLAN



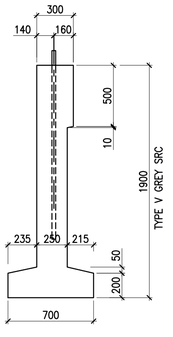
SECTION-C
SHOWING REINF.

FOOTING - F12

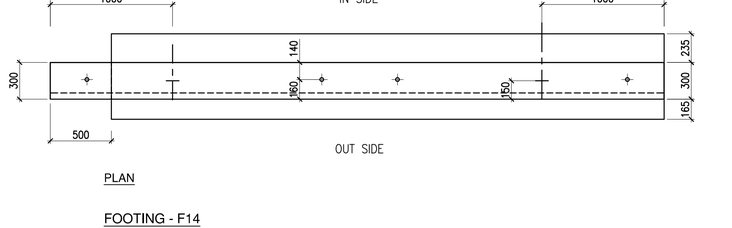
Nos. REQD. = 1 VOLUME 3.20 m³



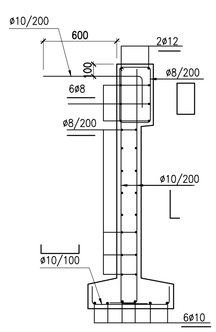
ELEVATION



SECTION-C



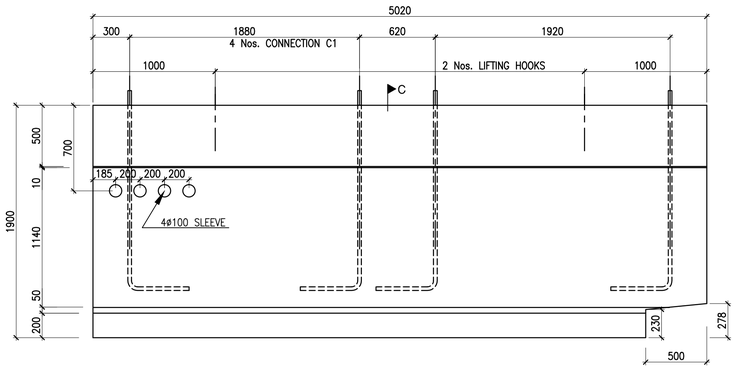
PLAN



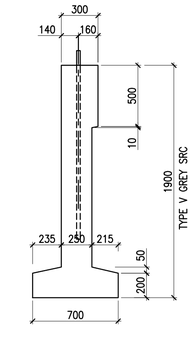
SECTION-C
SHOWING REINF.

FOOTING - F14

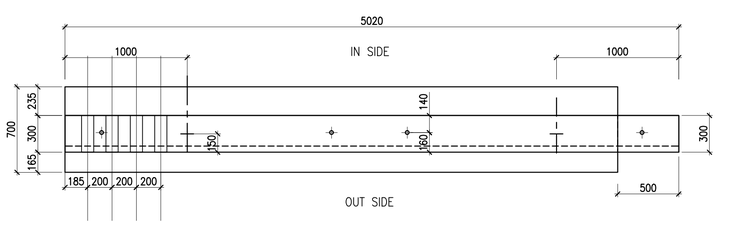
Nos. REQD. = 1 VOLUME 3.20 m³



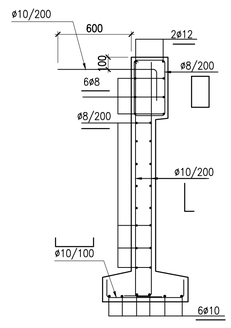
ELEVATION



SECTION-C



PLAN



SECTION-C
SHOWING REINF.

FOOTING - F15

Nos. REQD. = 2 VOLUME 3.20 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

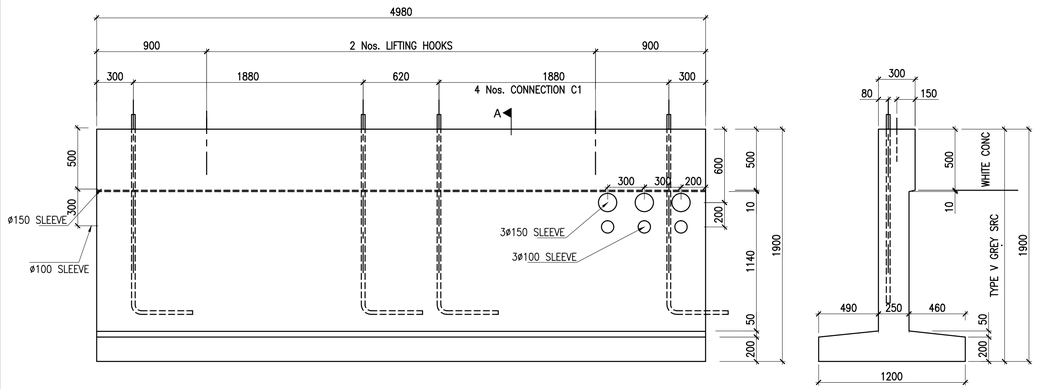
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

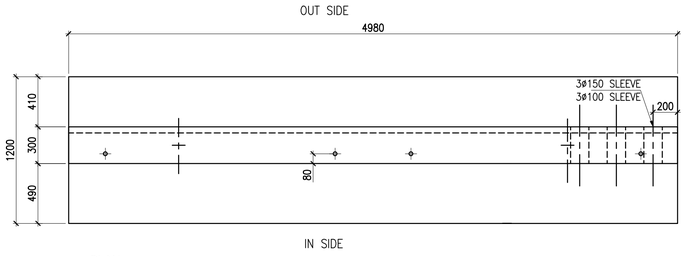
DRAWING NO. RA140-32-BUI-CW-DW-65657-4
REV. C1

A0(841X1189mm +2mm)

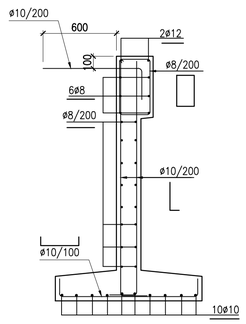


ELEVATION

SECTION-A



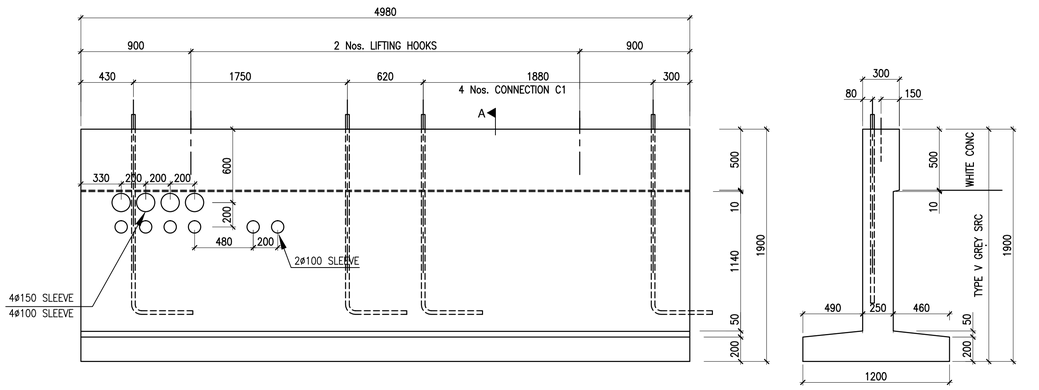
PLAN



SECTION-A
SHOWING REINF.

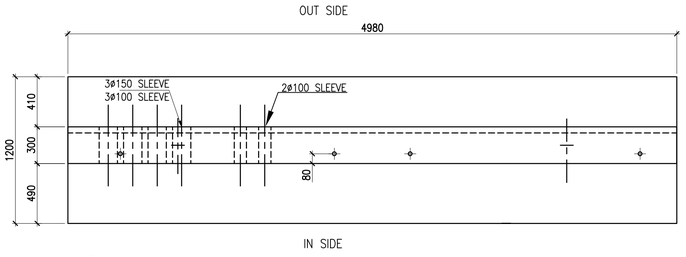
FOOTING - F2.1

Nos. REQD. = 1 VOLUME 3.68 m³

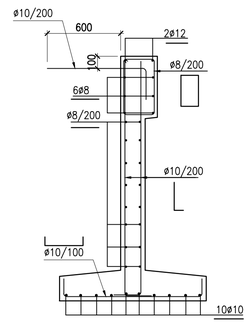


ELEVATION

SECTION-A



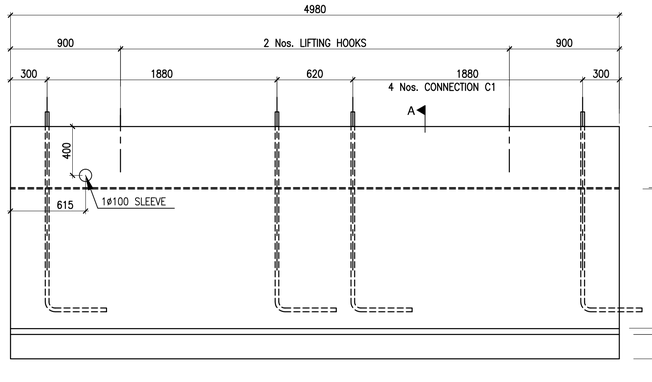
PLAN



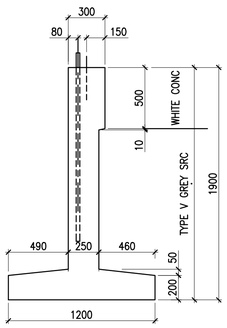
SECTION-A
SHOWING REINF.

FOOTING - F2.2

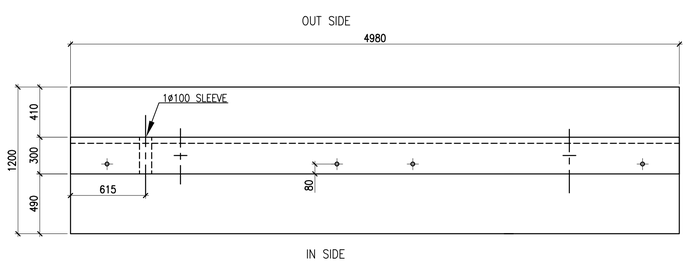
Nos. REQD. = 1 VOLUME 3.68 m³



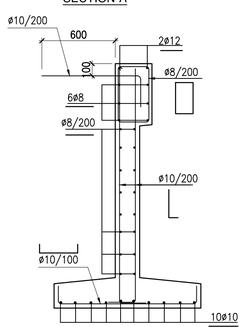
ELEVATION



SECTION-A



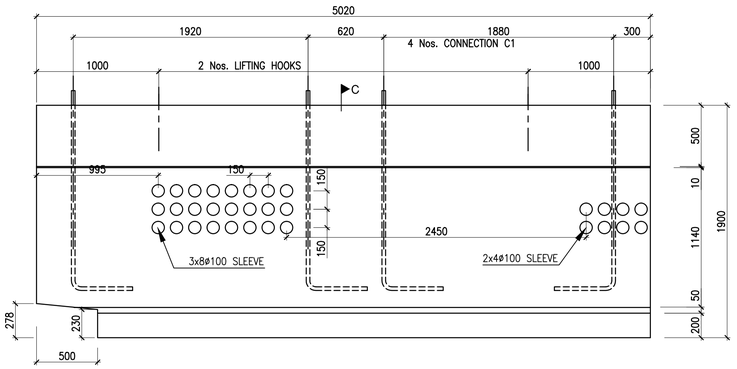
PLAN



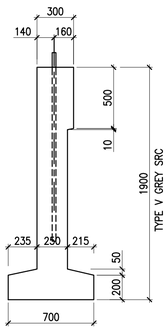
SECTION-A
SHOWING REINF.

FOOTING - F2.2

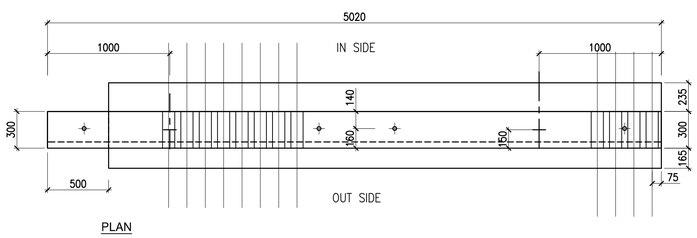
Nos. REQD. = 1 VOLUME 3.68 m³



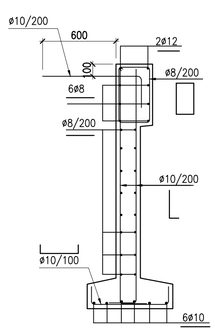
ELEVATION



SECTION-C



PLAN



SECTION-C
SHOWING REINF.

FOOTING - F14.1

Nos. REQD. = 1 VOLUME 3.20 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

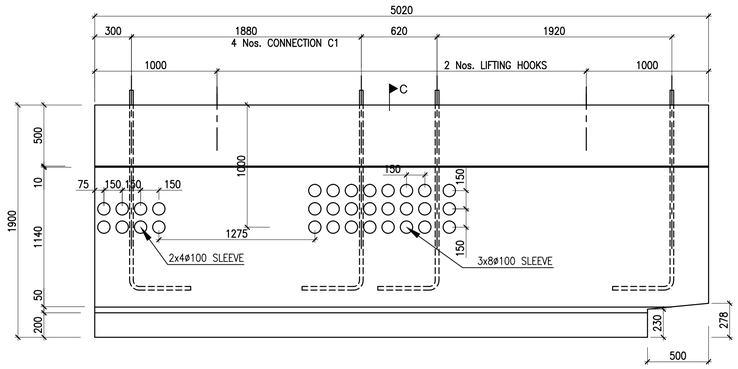
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL:23260054, FAX :23260067.

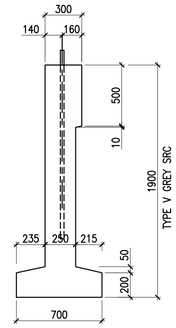
DRAWING NO.
RA140-32-BUI-CW-DW-65657-5

REV.
C1

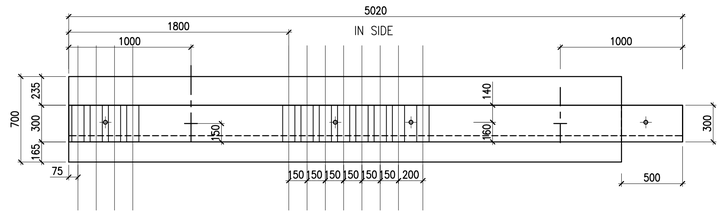
A0(841X1189mm +2mm)



ELEVATION

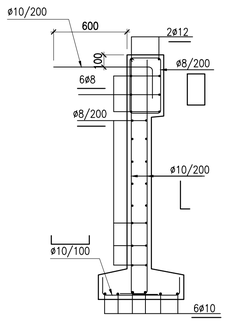


SECTION-C



PLAN

OUT SIDE



SECTION-C
SHOWING REINF.

FOOTING - F15.1

Nos. REQD. = 1 VOLUME 3.20 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
FOOTING UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

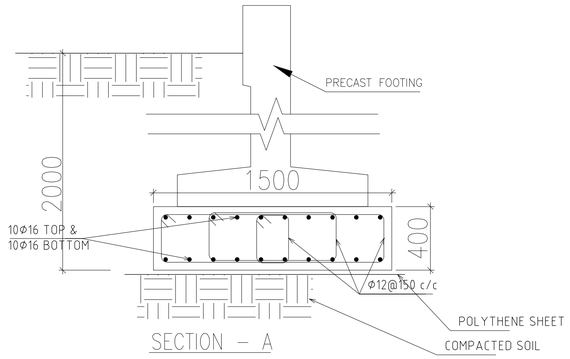
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65657-6
REV. C1

A0(841x1189mm +2mm)

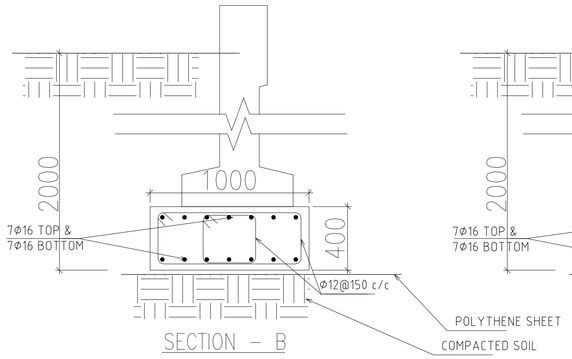
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.
2. 28 DAYS CUBE STRENGTH OF CONCRETE = 30 MPa.
3. USE CEMENT TYPE V (SRC) TO ASTM C150.
4. CLEAR COVER TO REINFORCEMENT = 50 mm.
5. REINFORCING STEEL GRADE 60 TO ASTM A615.



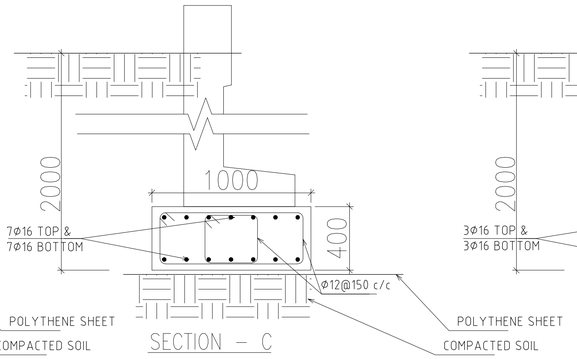
SECTION – A

TIE BEAM 1500 X 400 mm



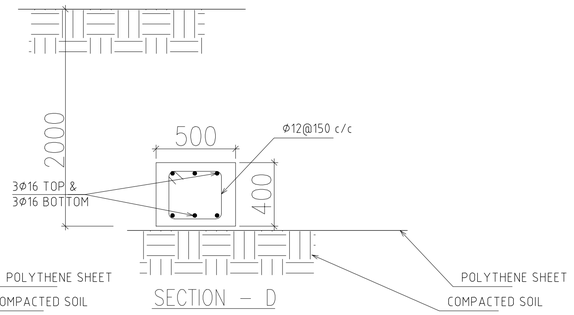
SECTION – B

TIE BEAM 1000 X 400 mm



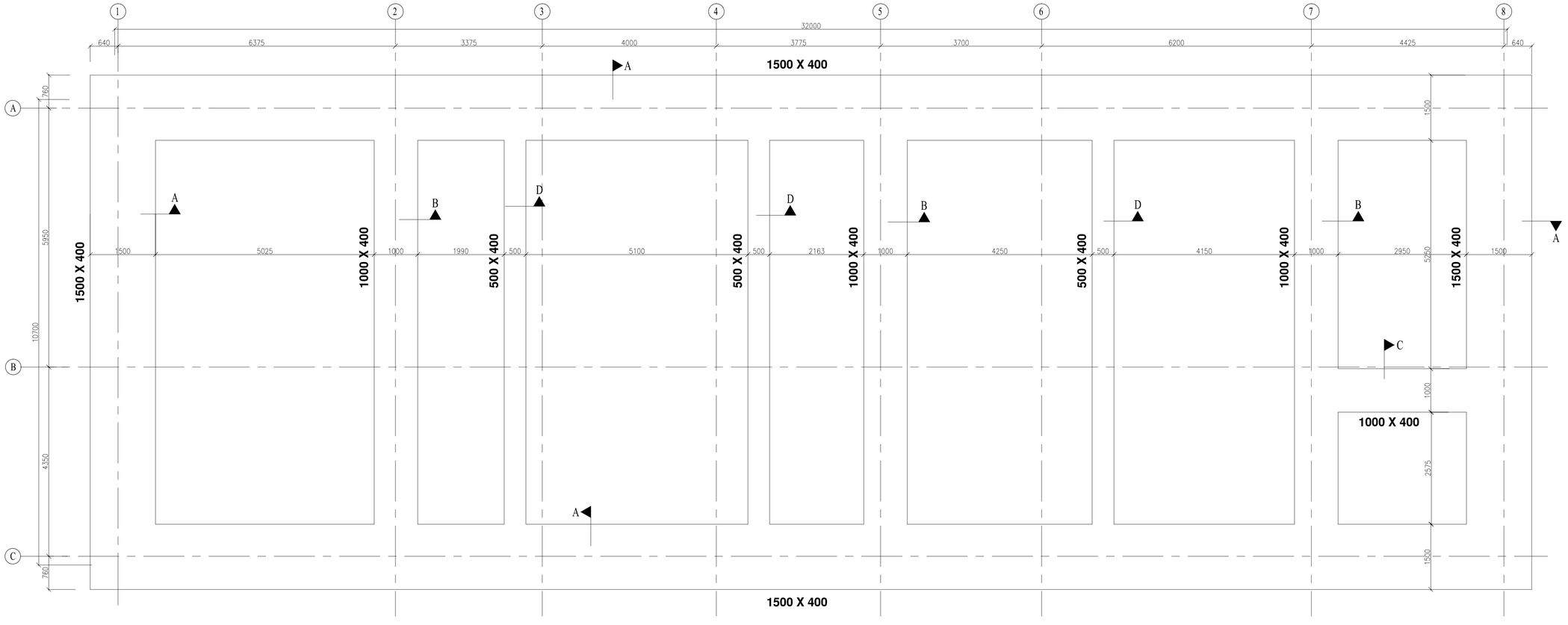
SECTION – C

TIE BEAM 1000 X 400 mm



SECTION – D

TIE BEAM 500 X 400 mm



CAST IN SITU RCC TIE BEAM - PLAN

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
CAST- IN SITU RCC TIE BEAM DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

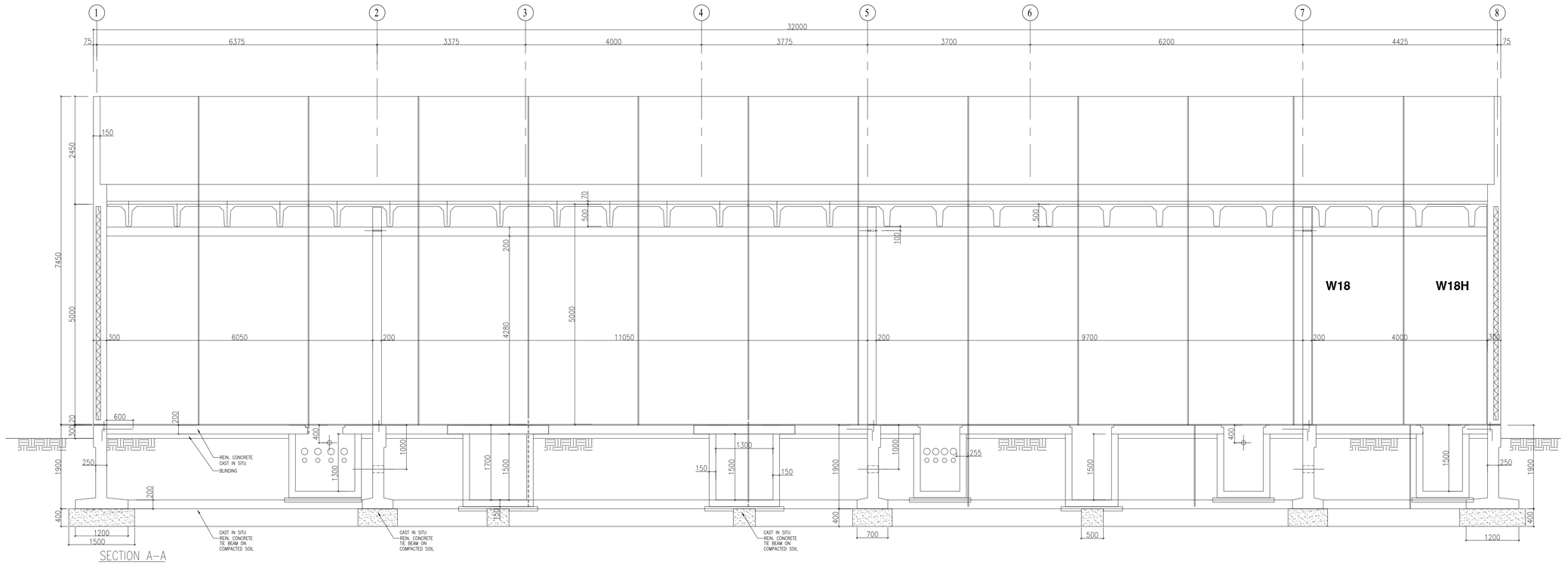
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65658

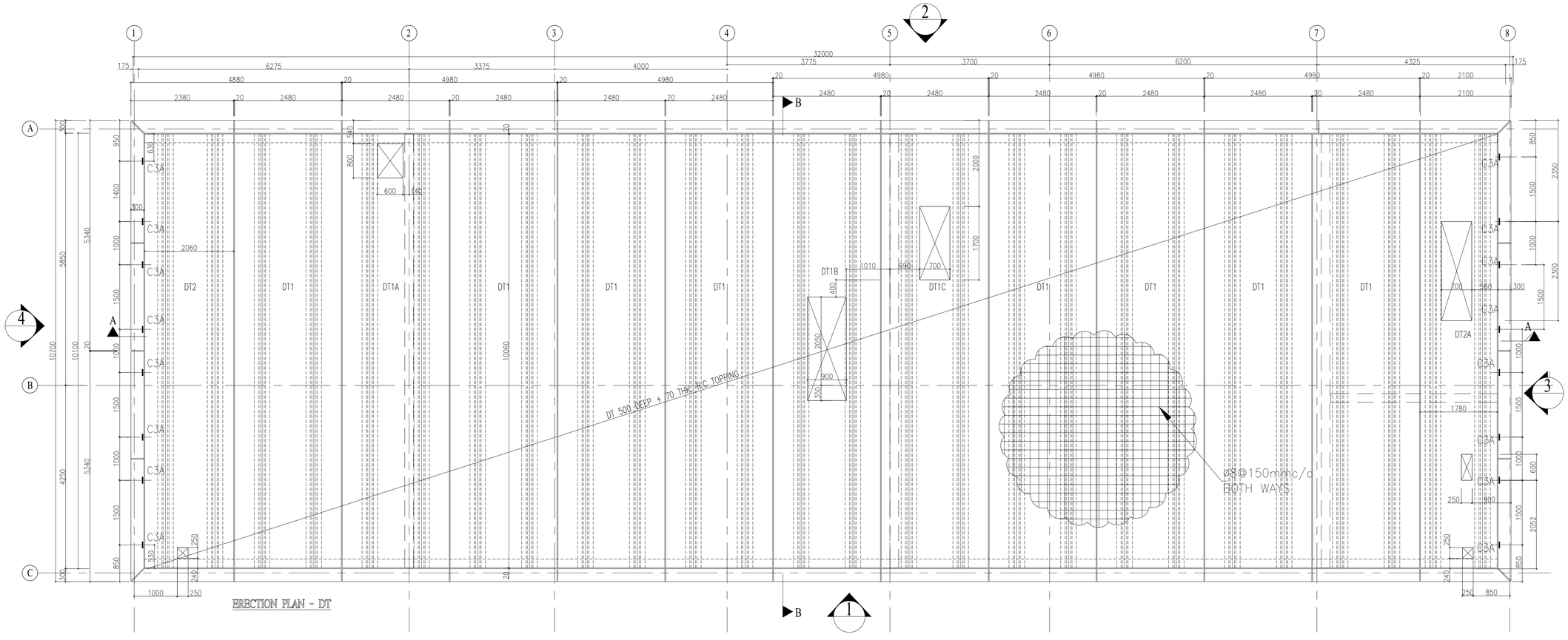
REV. C1

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



SECTION A–A



ERECTION PLAN - DT

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
ERECTION PLAN DT & SECTION A-A

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

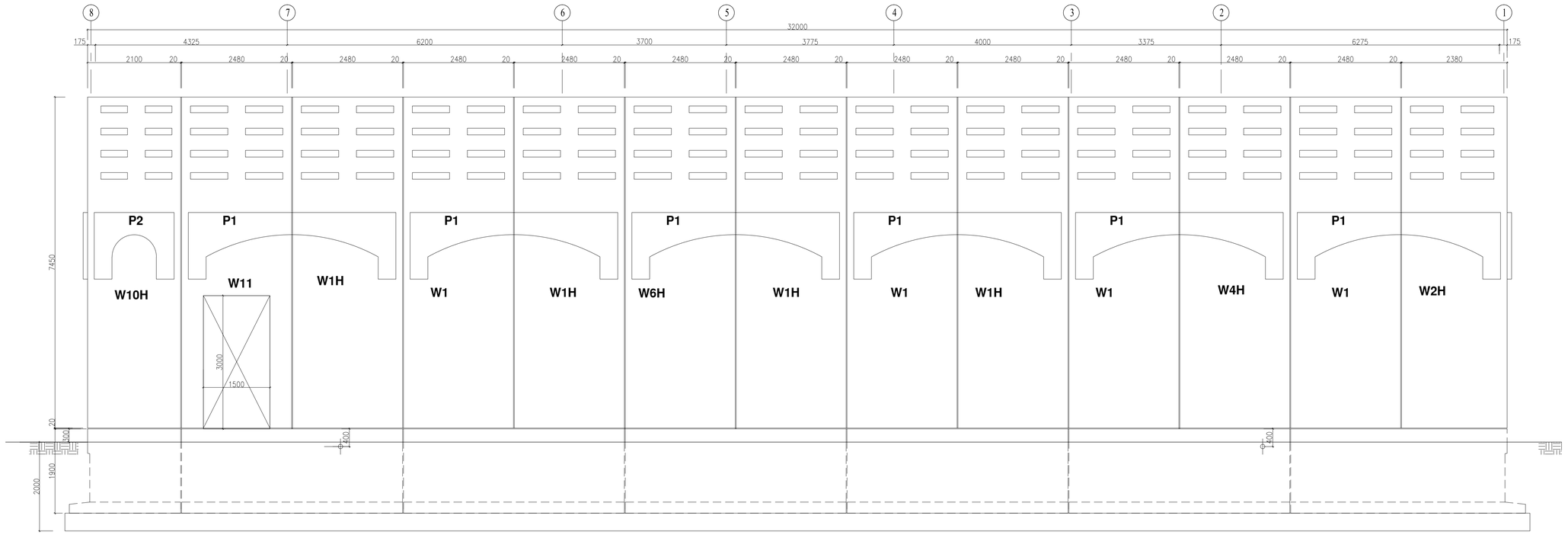
DRAWING NO. RA140-32-BUI-CW-DW-65559

REV. C1

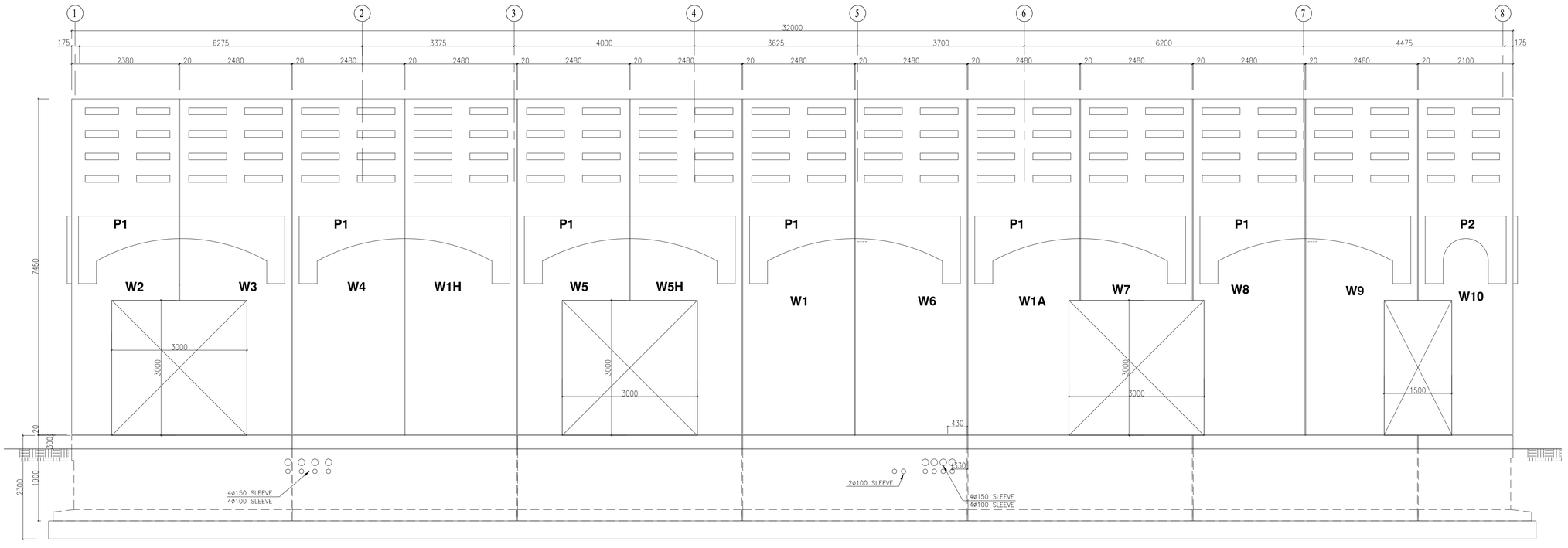
A0(841x1189mm +20mm)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



ELEVATION –2



ELEVATION –1

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
ELEVATIONS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

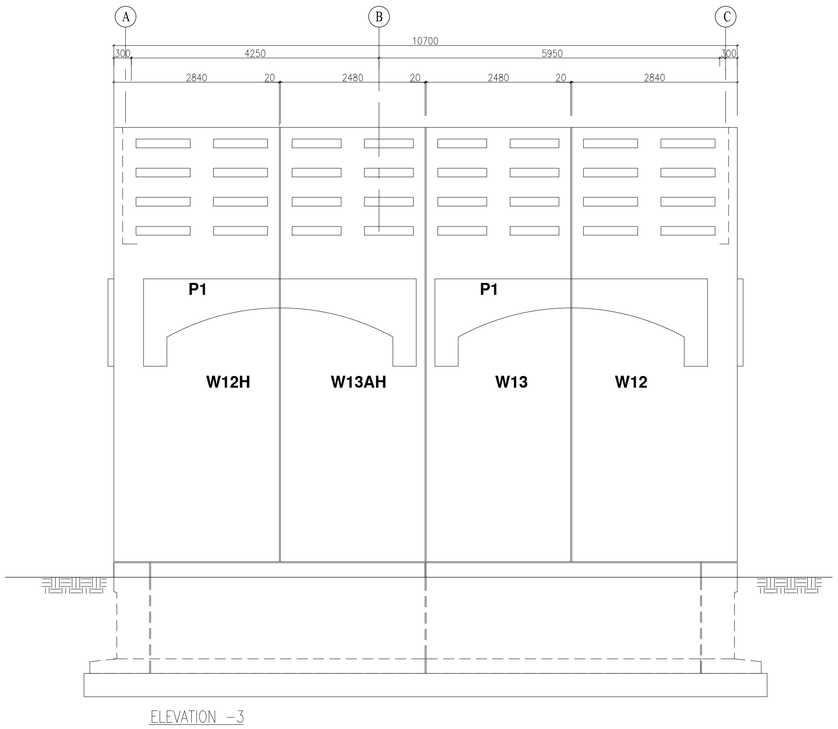
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

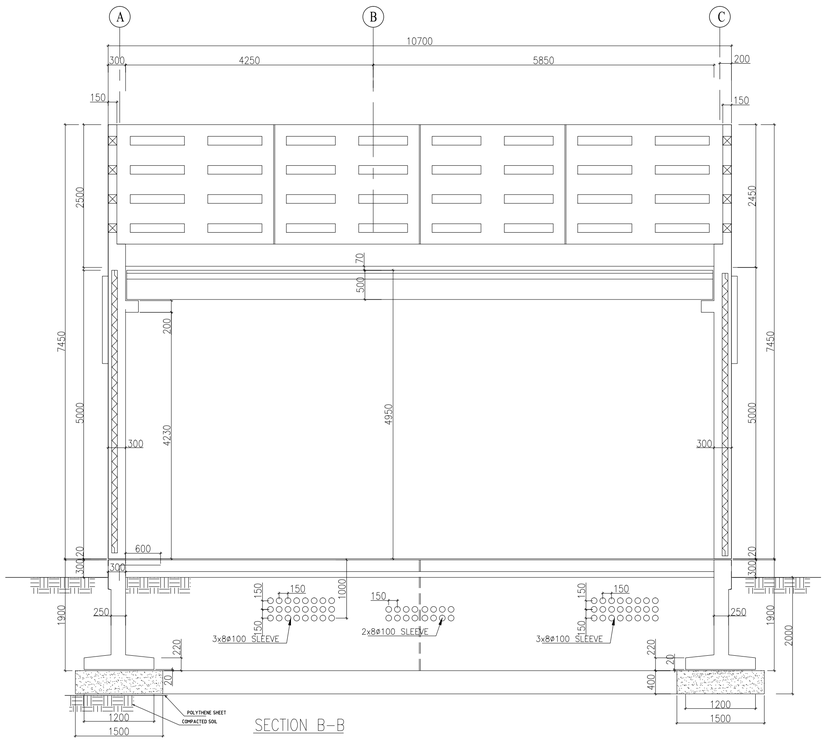
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX :24478, SAFAT :13105, KUWAIT. TEL:23260054, FAX :23260067.

DRAWING NO.	REV.
RA140-32-BUI-CW-DW-65660-1	C1

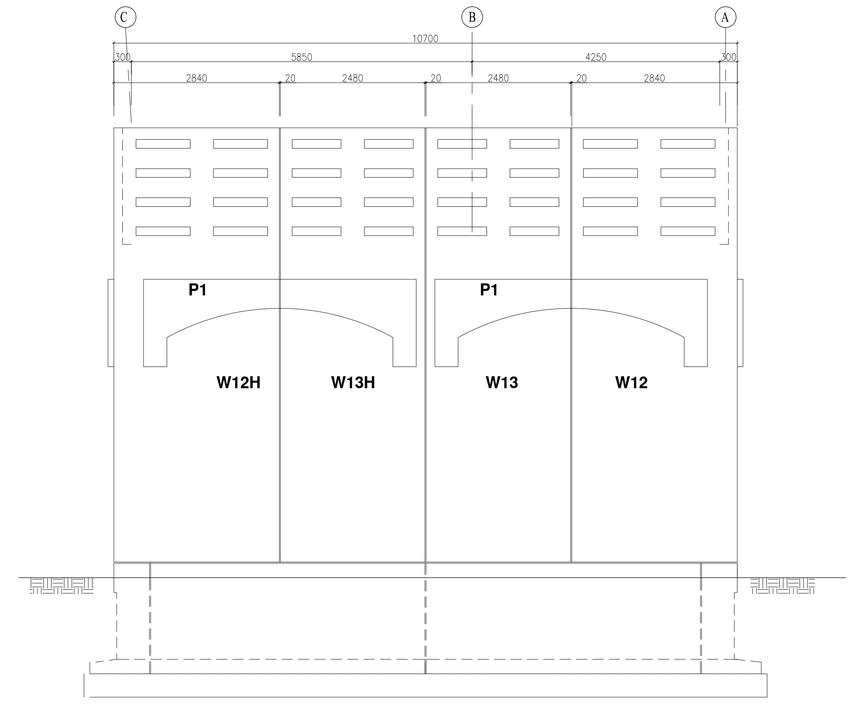
A0(841x1197mm +2mm)



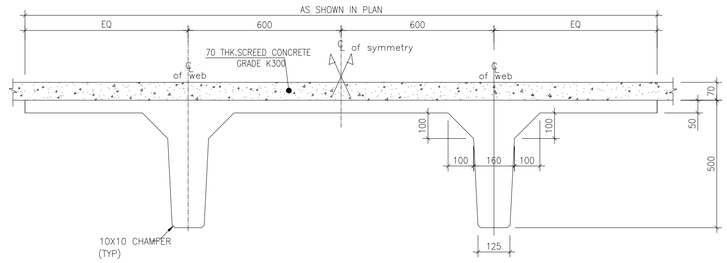
ELEVATION –3



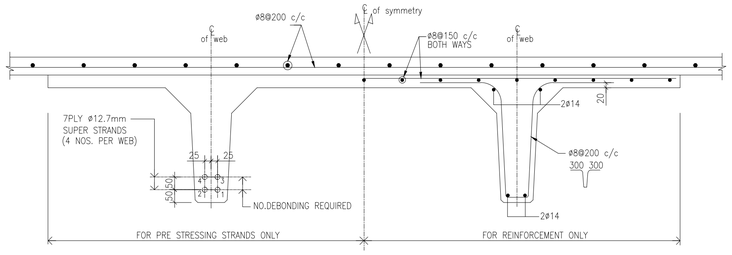
SECTION B–B



ELEVATION –4



SECTION 1-1
(SHOWING DIMENSIONS)
SCALE – 1:10



SECTION 1-1
(SHOWING R/F. & STRANDS)
SCALE – 1:10

DOUBLE TEE DETAILS (TYP.)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
ELEVATIONS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50				
DATE ISSUED	EJL	JSK	HSH	BCP
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

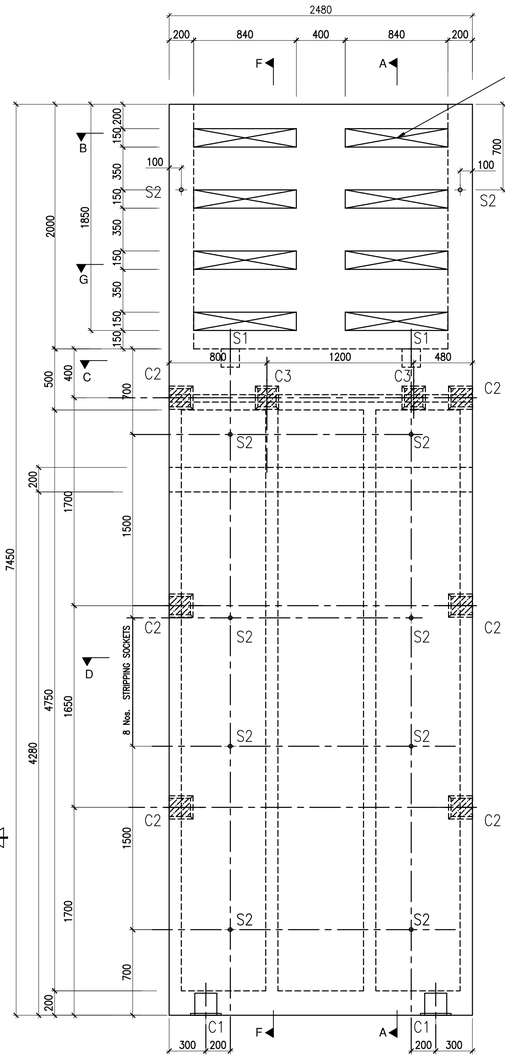
DRAWING NO.

RA140-32-BUI-CW-DW-65660-2

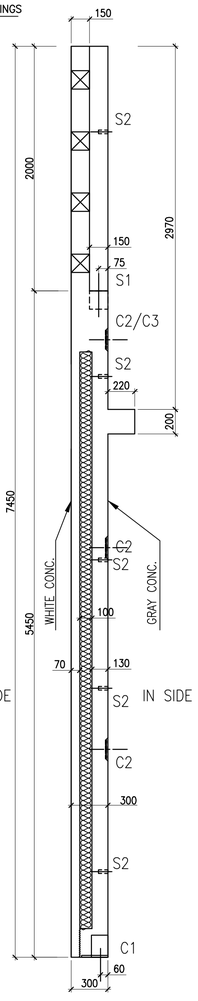
REV.

C1

A0(841x1189mm +27mm)

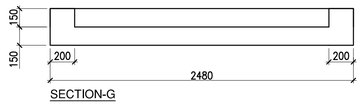


ELEVATION

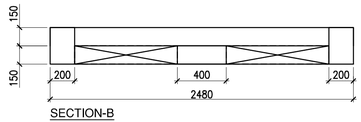


SECTION A-A

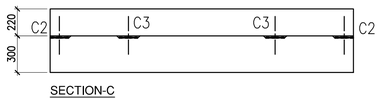
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS



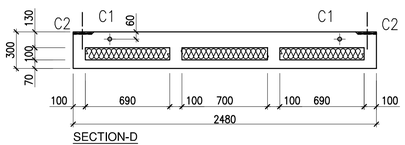
SECTION-G



SECTION-B



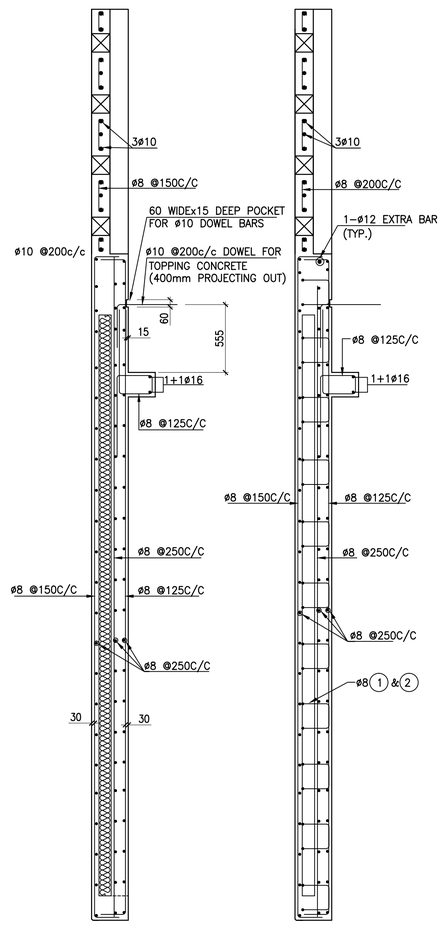
SECTION-C



SECTION-D

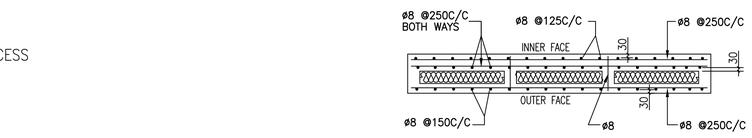
WALL- W1

Nos. REQD. = 5 VOLUME 4.62 m³

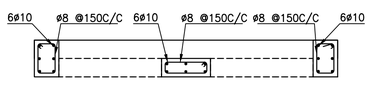


SECTION A-A
(SHOWING REINFORCEMENT)

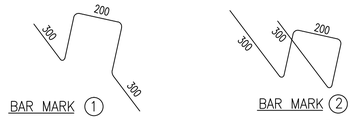
SECTION F-F
(SHOWING REINFORCEMENT)



SECTION-D
(SHOWING REINF.)

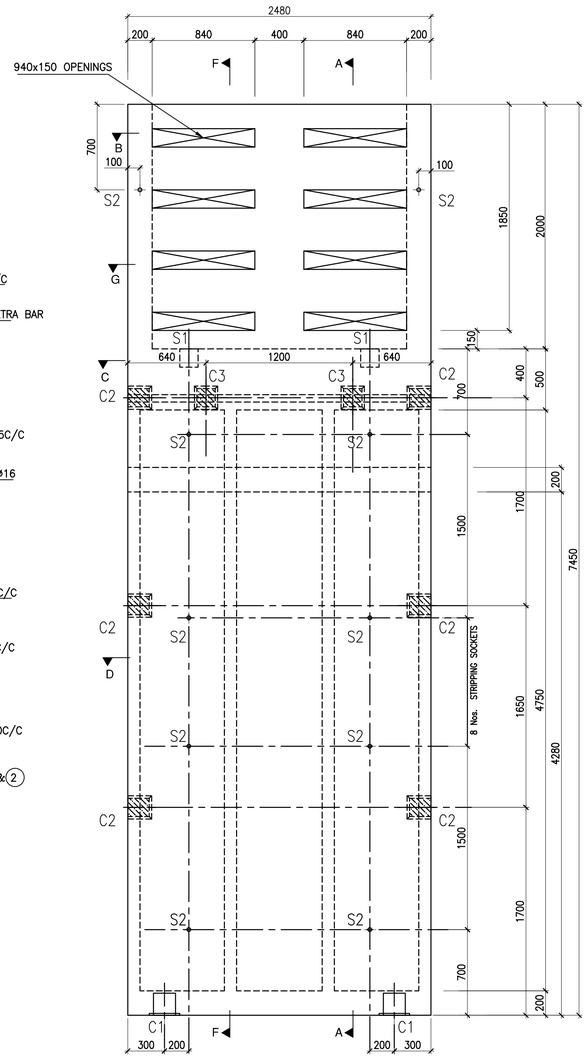


SECTION-B
(SHOWING REINF.)



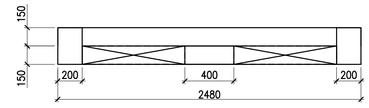
ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL RED OXIDE PAINTED.

AS A RESULT OF DELETING THE ARCH GROOVE AND ADDING SEPARATE ARCH UNIT, W1 & W1H ARE SAME AS EACH OTHER

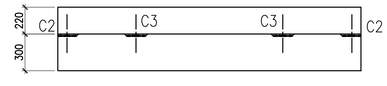


ELEVATION

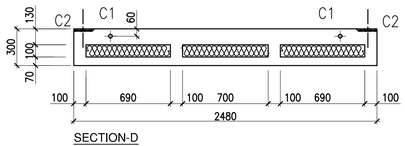
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS



SECTION-B



SECTION-C



SECTION-D

WALL- W1H

Nos. REQD. = 5 VOLUME 4.62 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TWALL UNIT DETAILS

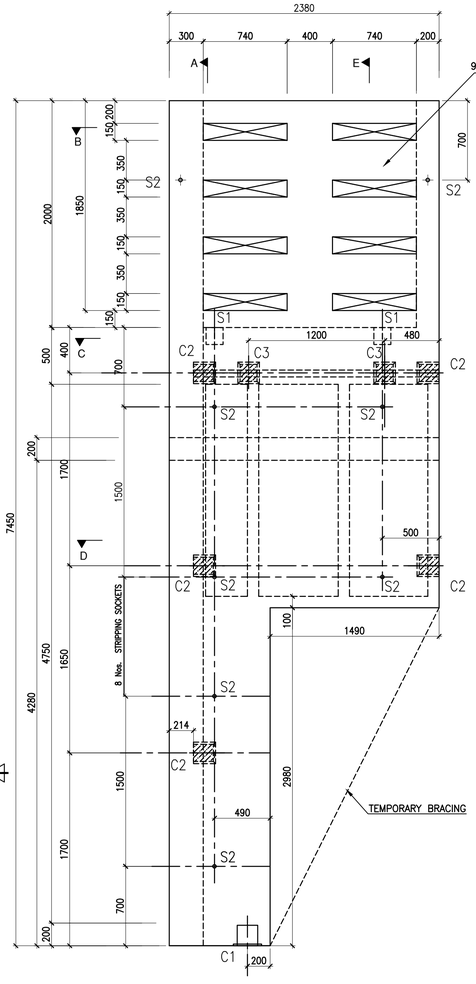
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

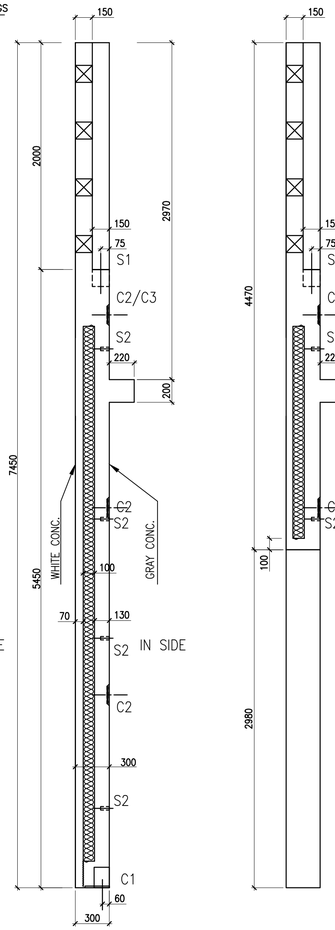
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65661-1
REV. C1

A0(1413/1189mm + 25mm)

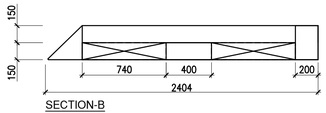


ELEVATION



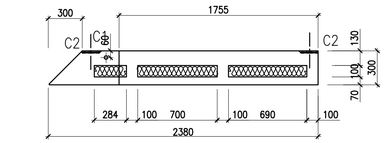
SECTION-A

SECTION-B



SECTION-B

SECTION-C



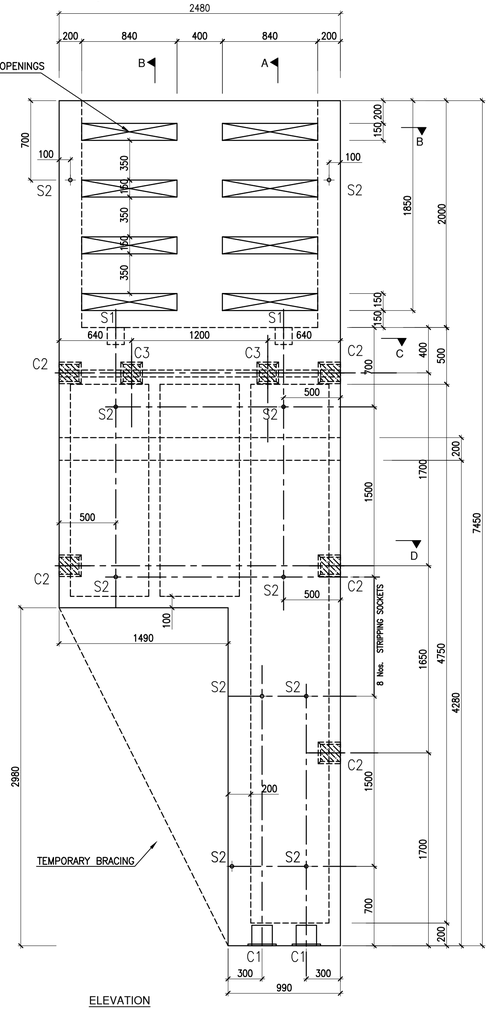
SECTION-D

C1– 1 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

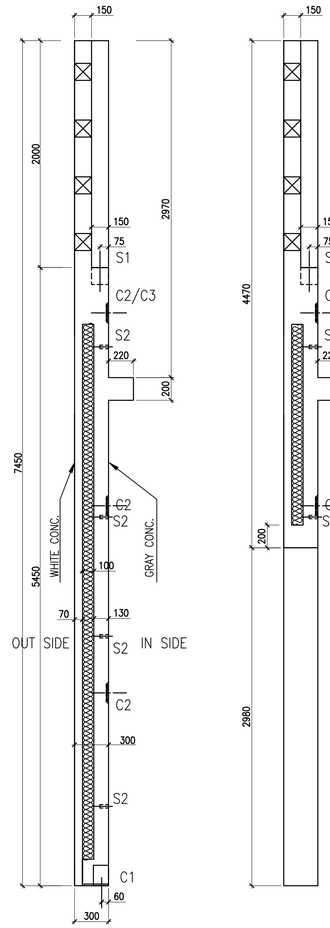
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W2

Nos. REQD. = 1 VOLUME 3.60 m³

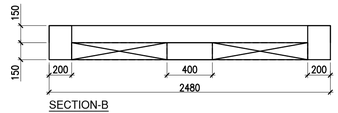


ELEVATION

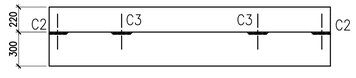


SECTION-A

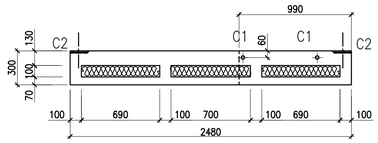
SECTION-B



SECTION-B



SECTION-C



SECTION-D

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W3

Nos. REQD. = 1 VOLUME 3.52 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A–615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

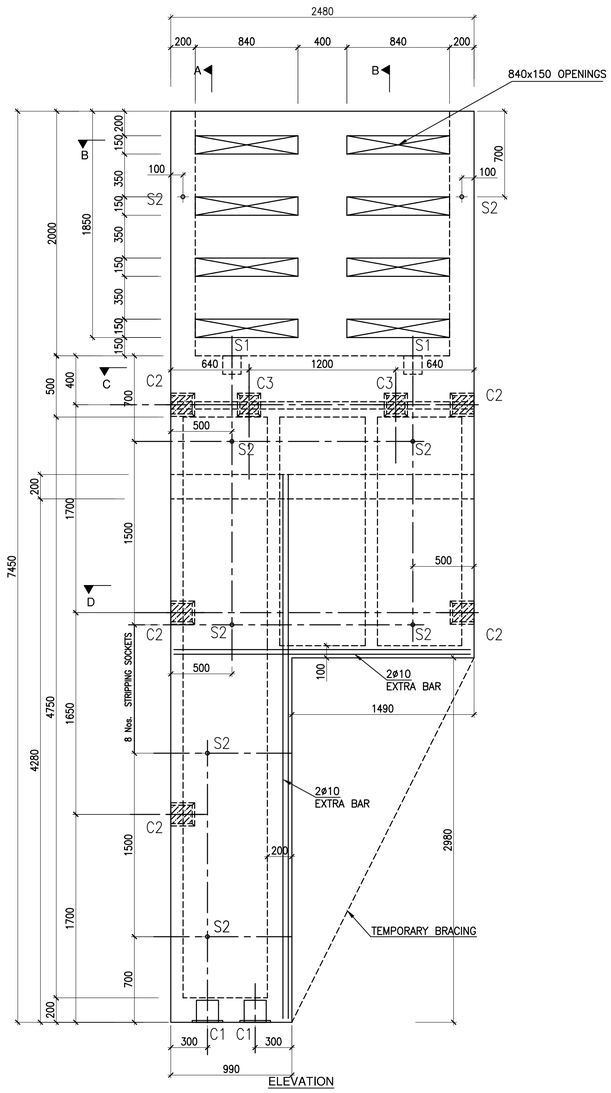
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

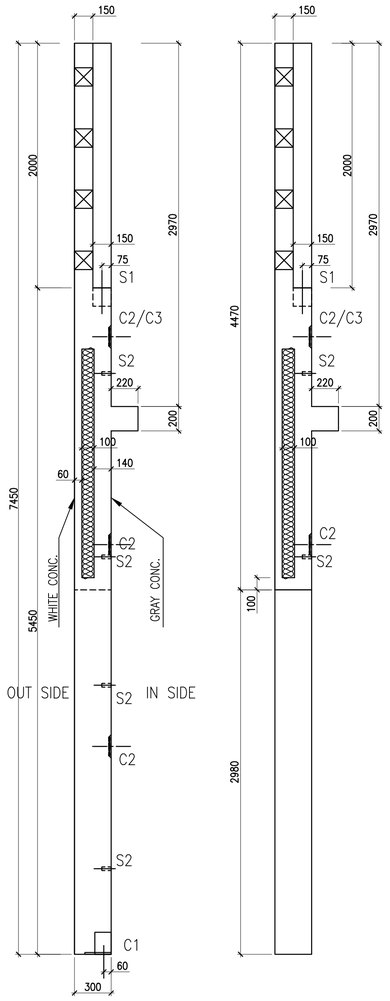
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT 13105, KUWAIT. TEL.:25260054, FAX :25260067.

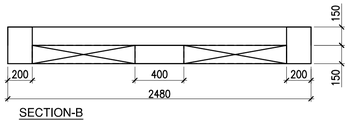
DRAWING NO. RA140-32-BUI-CW-DW-65661-2
REV. C1

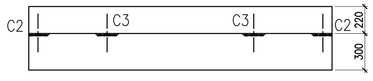
A0(841x1189mm +2mm)

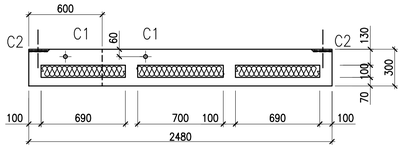




SECTION-B


SECTION-B


SECTION-C

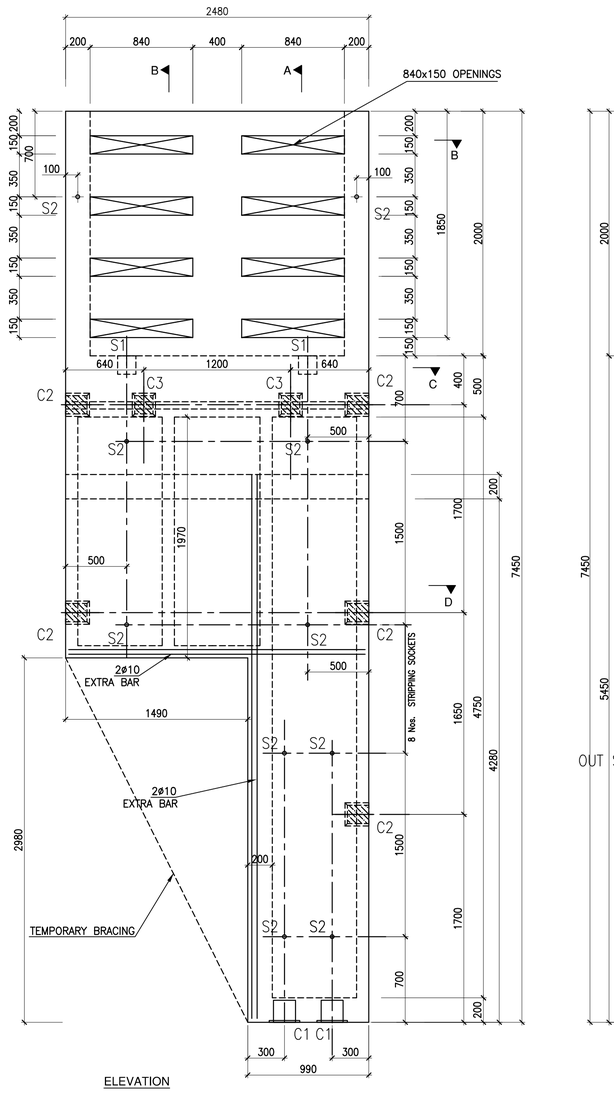

SECTION-D

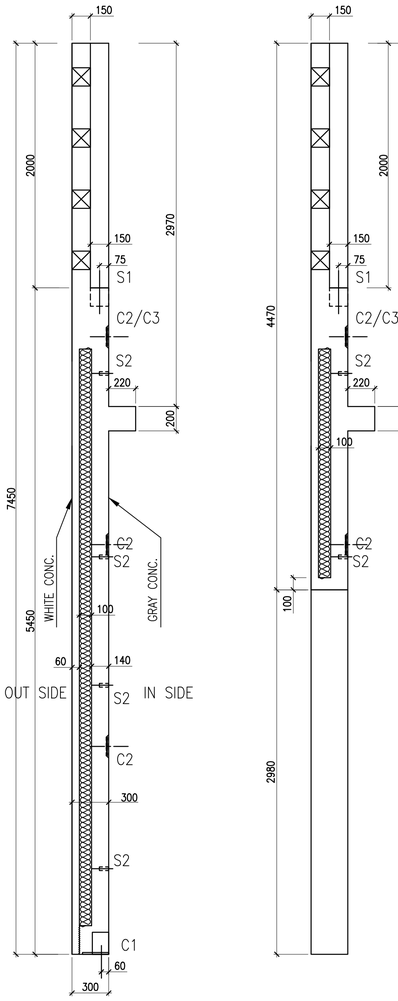
WALL- W5

Nos. REQD. = 1 VOLUME 3.52 m³

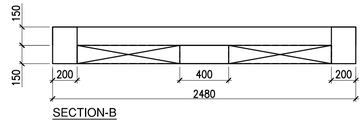
C1– 1 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

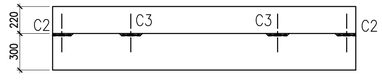
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

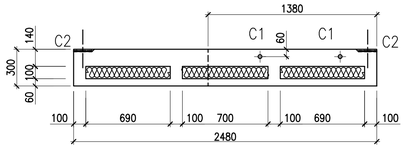




SECTION-B


SECTION-B


SECTION-C


SECTION-D

WALL- W5H

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

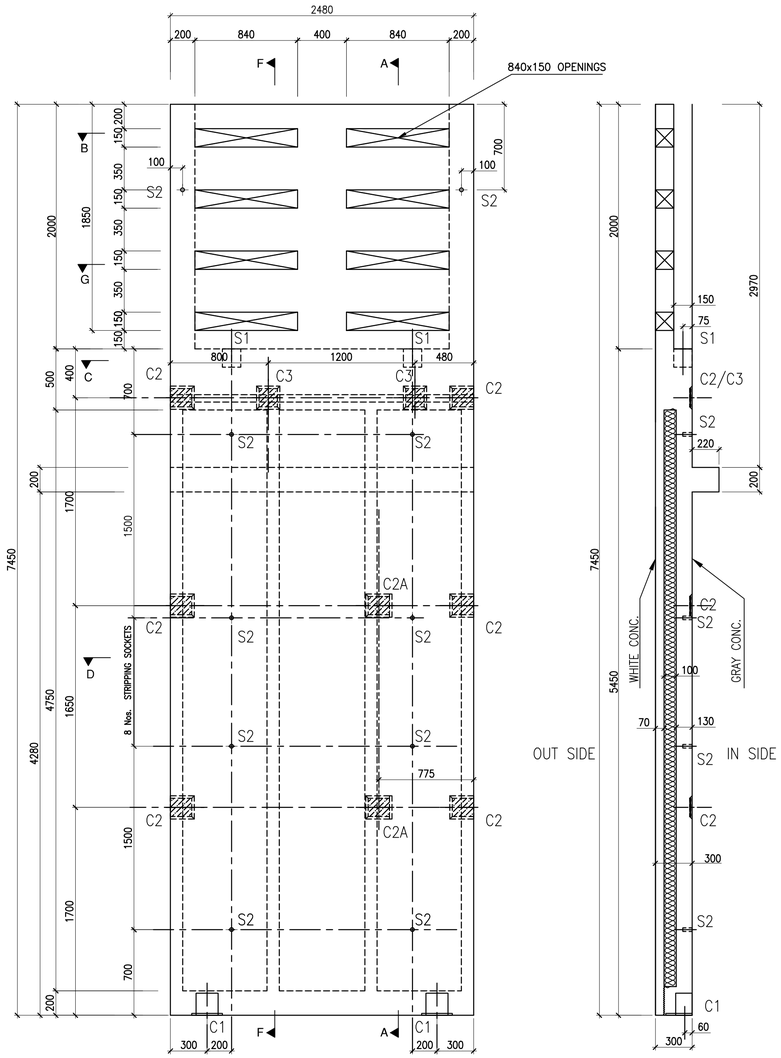
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

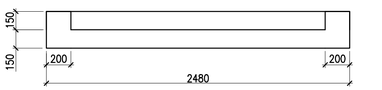
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

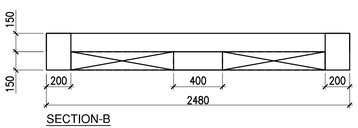
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

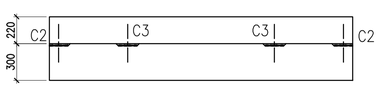
DRAWING NO. RA140-32-BUI-CW-DW-65661-3
REV. C1

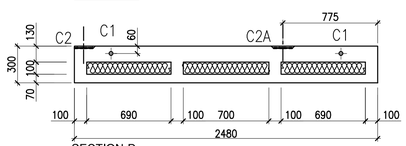
A0(841X1187mm +-2mm)









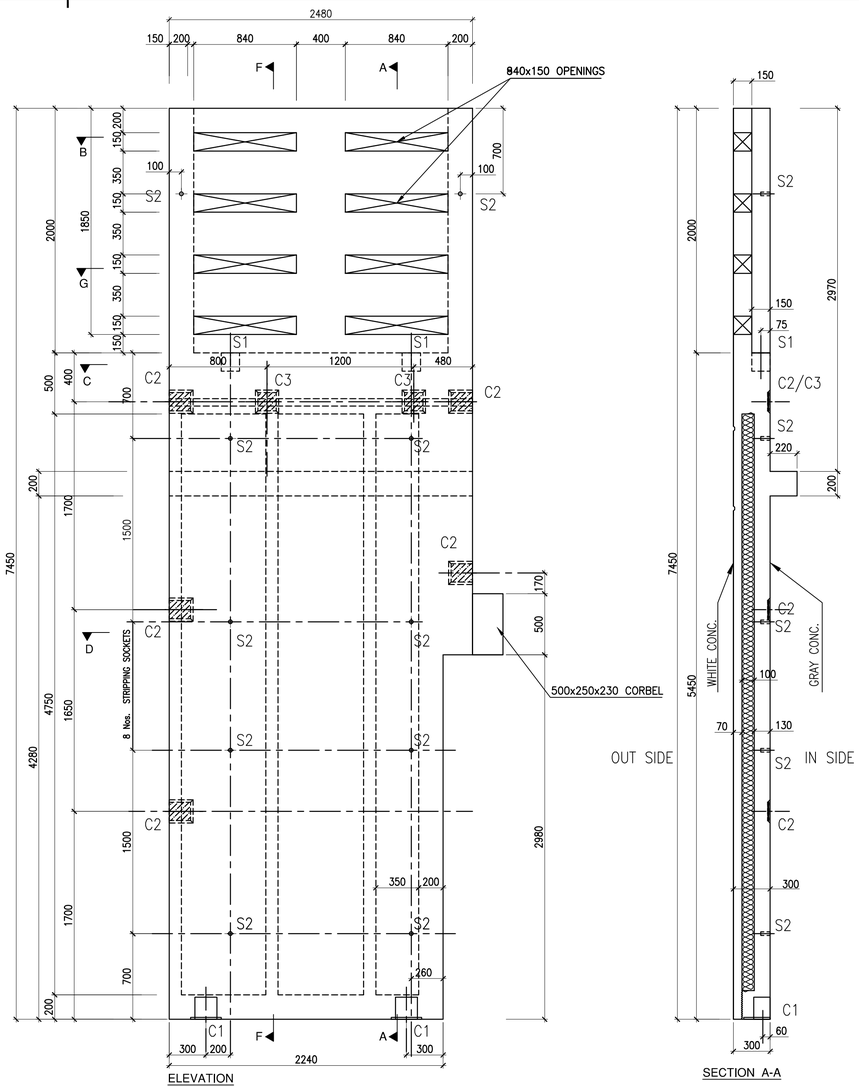


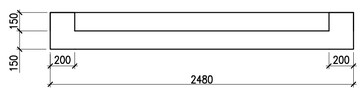
WALL- W4

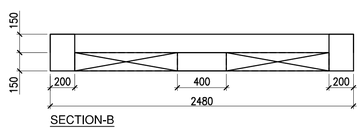
Nos. REQD. = 1 VOLUME 4.62 m³

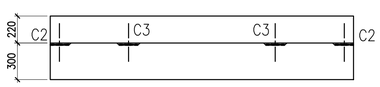
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

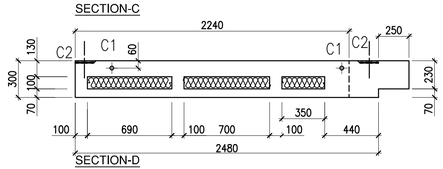
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001











WALL- W1A

Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
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REFER DWG.No. STUW–001

NOTES

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SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
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COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

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C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

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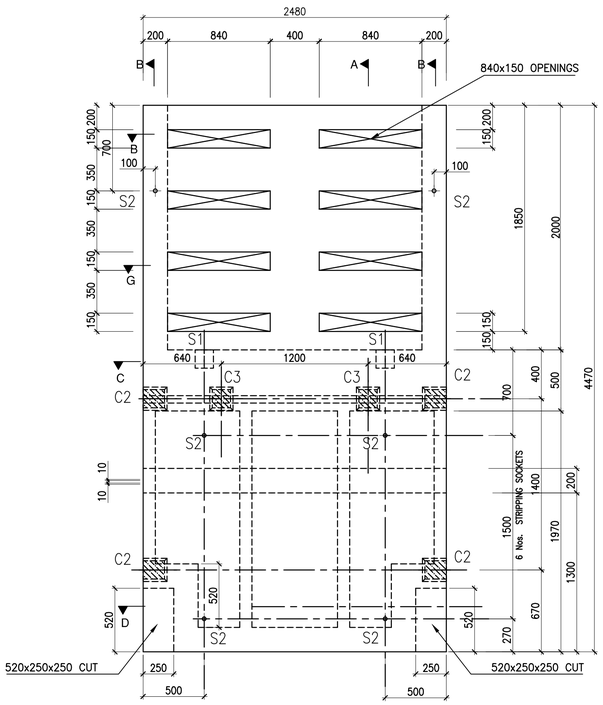
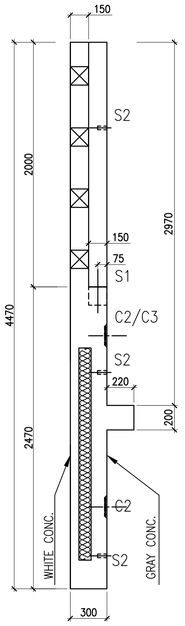
DRAWING NO. RA140-32-BUI-CW-DW-65661-4
REV. C1

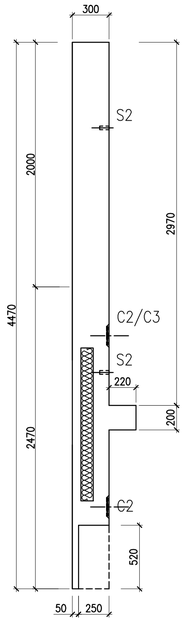
A0(841X1189mm +2mm)



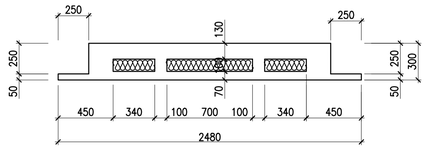
ELEVATION



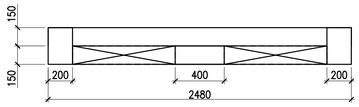
SECTION - A



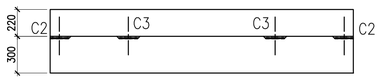
SECTION -B



SECTION-D



SECTION-B



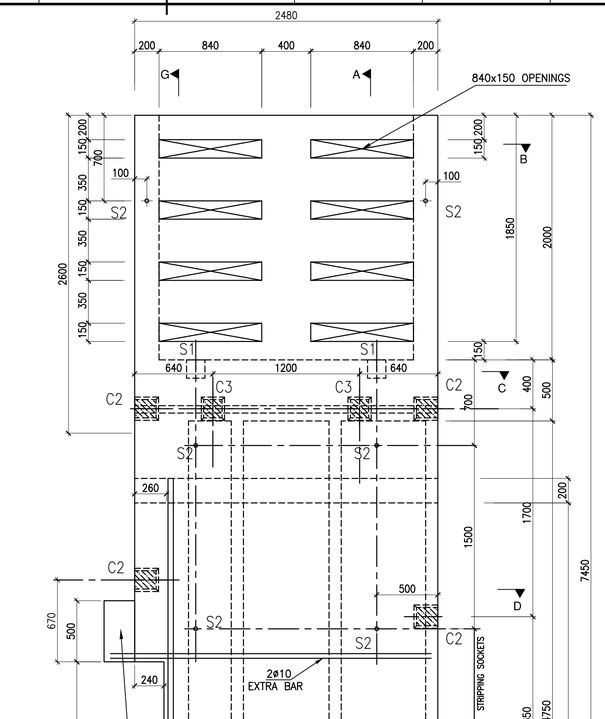
SECTION-C

WALL- W7

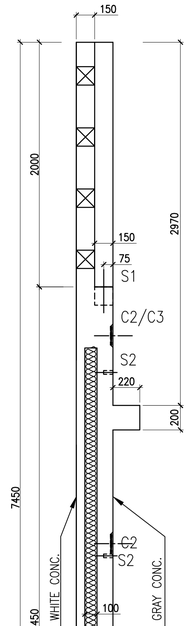
Nos. REQD. = 1 VOLUME 2.40 m³

C2– 4 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 6 No STRIPPING SOCKETS

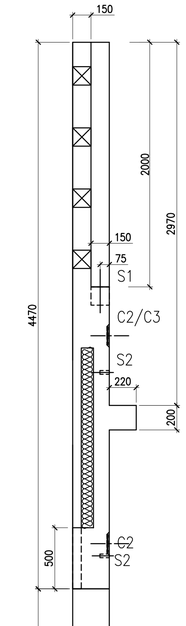
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



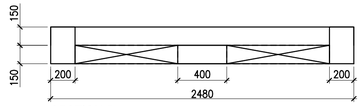
ELEVATION



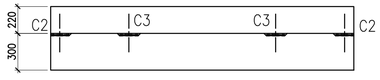
SECTION-A



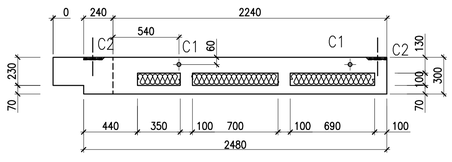
SECTION-G



SECTION-B



SECTION-C



SECTION-D

WALL- W8

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

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SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
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Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
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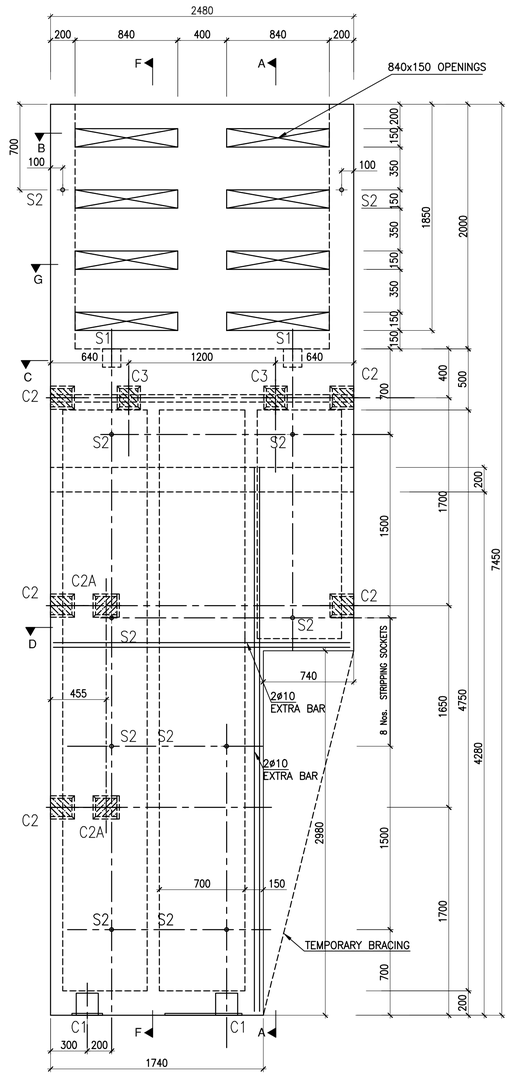
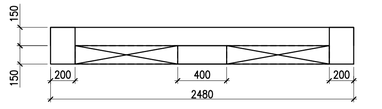
DRAWING NO. RA140-32-BUI-CW-DW-65661-5
REV. C1

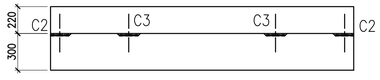
A0(841X1189mm +2mm)



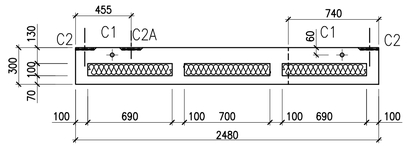
ELEVATION



SECTION-B



SECTION-C



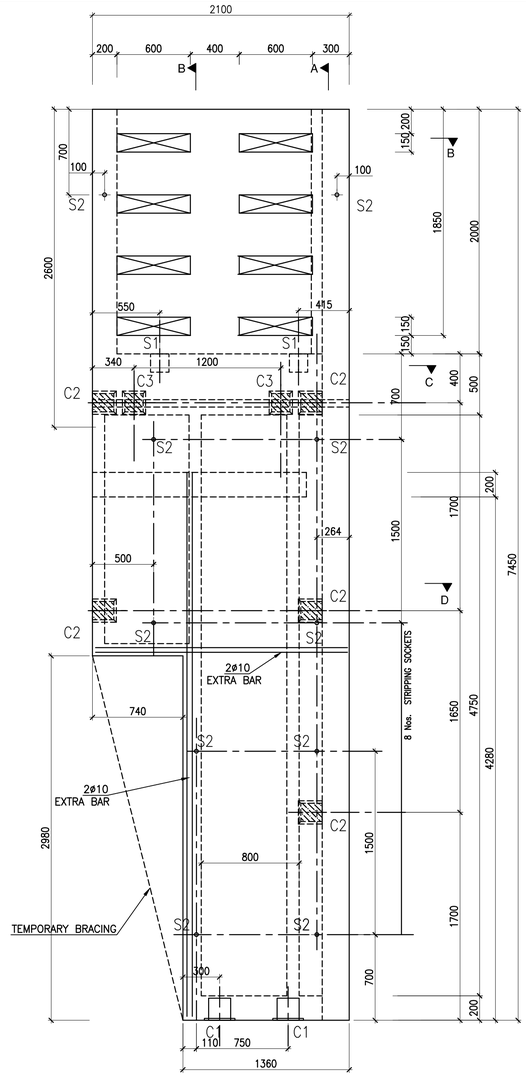
SECTION-D

WALL- W9

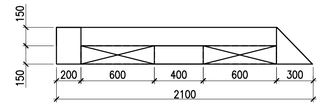
Nos. REQD. = 1 VOLUME 3.79 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

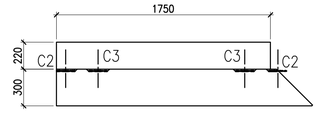
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



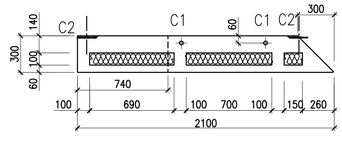
ELEVATION



SECTION-B



SECTION-C



SECTION-D

WALL- W10

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
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REFER DWG.No. STUW–001

NOTES

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SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED &
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CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM
YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH
CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
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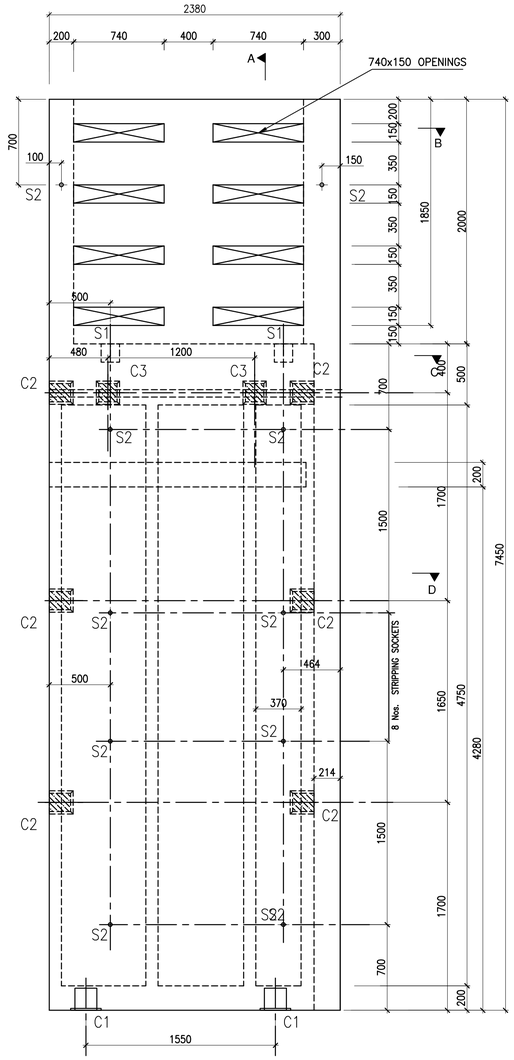
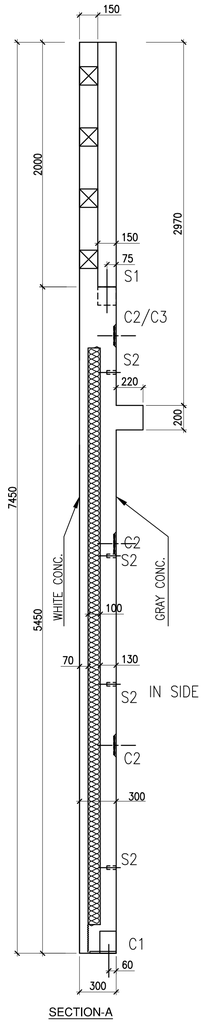
DRAWING NO. RA140-32-BUI-CW-DW-65661-6
REV. C1

A0(841X1189mm +2mm)



ELEVATION



SECTION-A

OUT SIDE

SECTION-B

SECTION-C

SECTION-D

WALL- W2H

Nos. REQD. = 1 VOLUME 3.60 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
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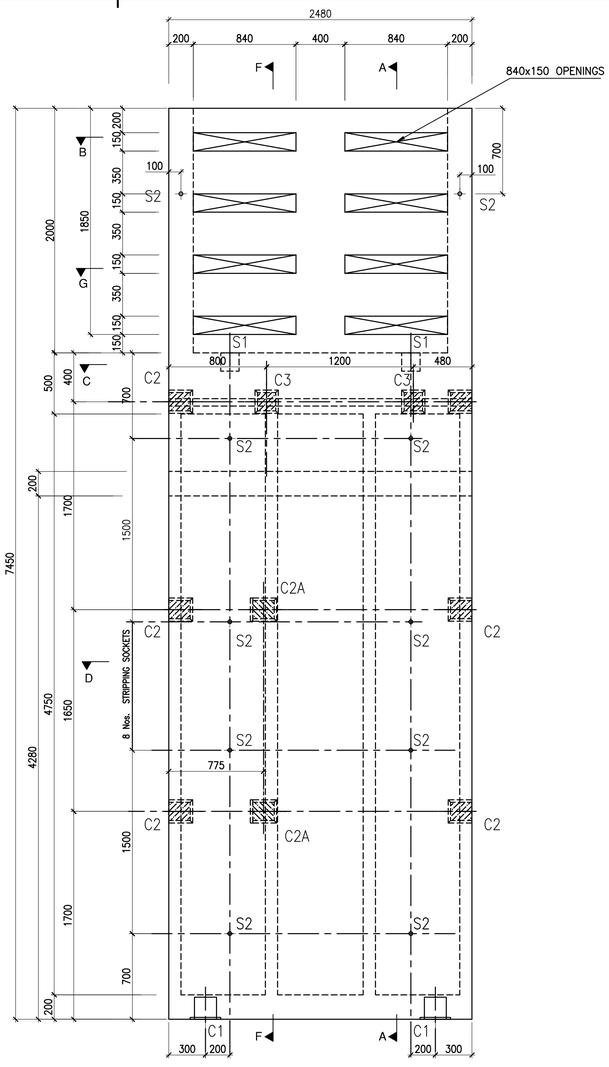

ELEVATION

SECTION-G

SECTION-B

SECTION-C

SECTION-D

WALL- W4H

Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
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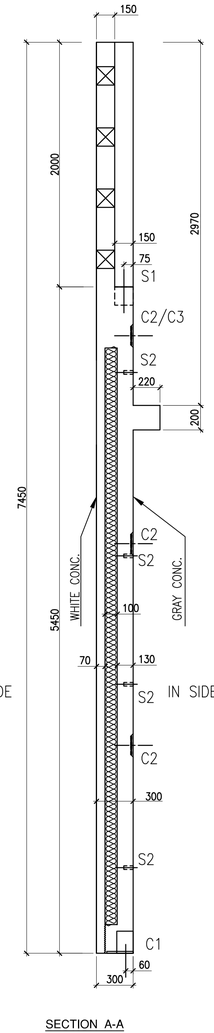

SECTION A-A

OUT SIDE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
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STRIPPING = 200 kg/cm²

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COVER
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25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
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CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

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1:25	EJL	JSK	HSH	BCP
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CONTRACTOR
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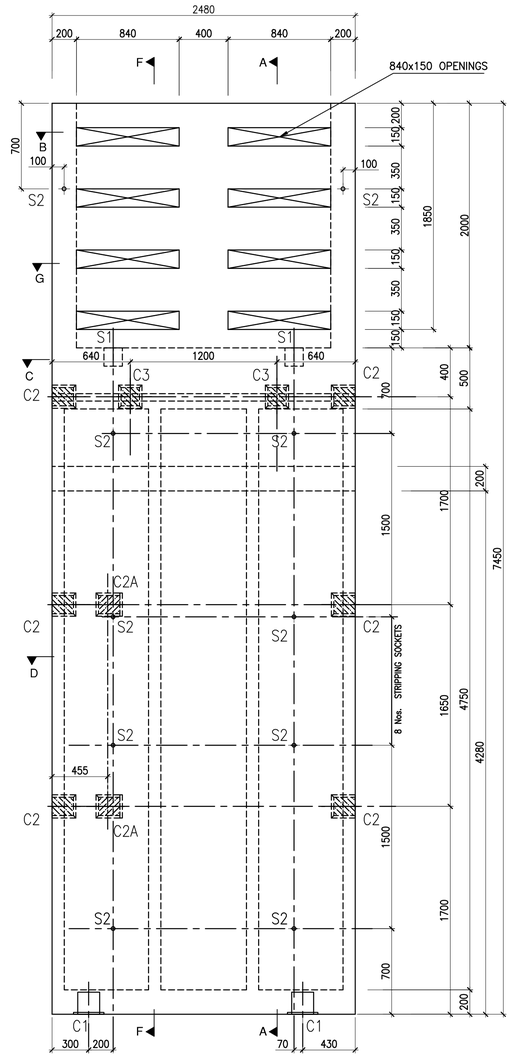
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24476, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

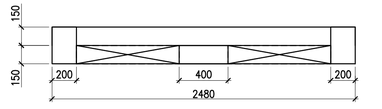
DRAWING NO.
RA140-32-BUI-CW-DW-65661-7

REV.
C1

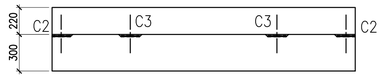
A0(841X1189mm +2mm)



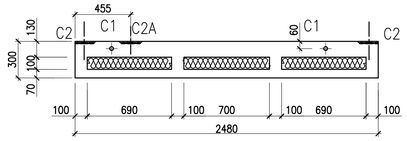
ELEVATION



SECTION-B



SECTION-C



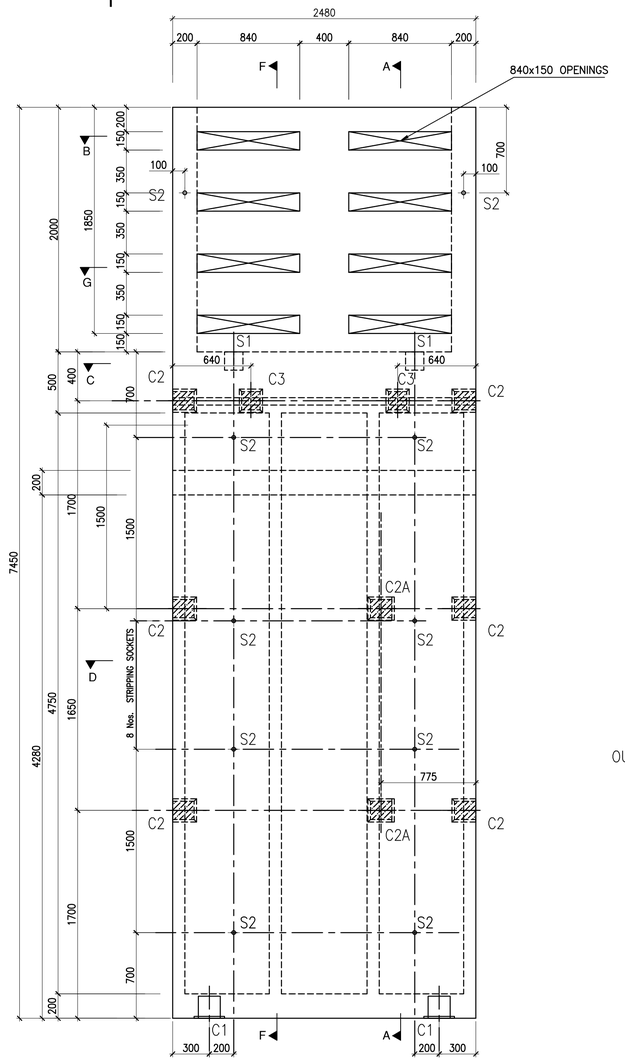
SECTION-D

WALL- W6

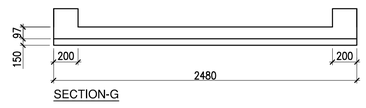
Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

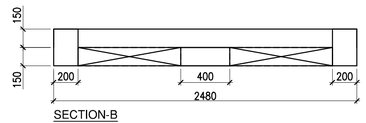
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



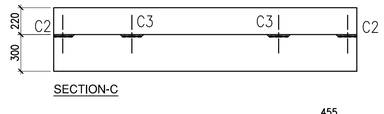
ELEVATION



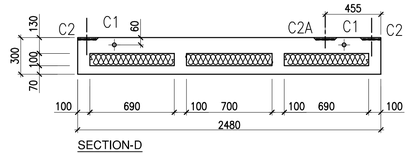
SECTION-G



SECTION-B



SECTION-C



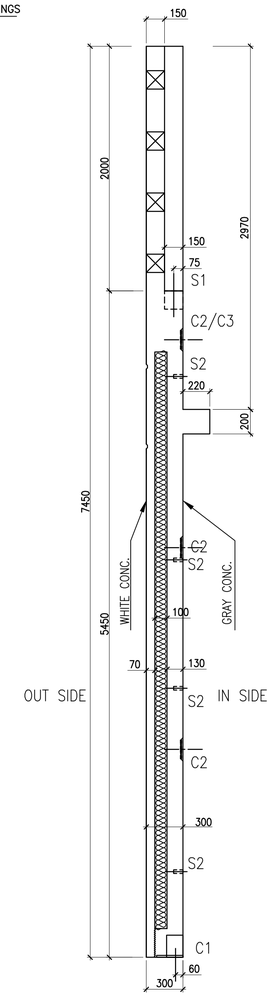
SECTION-D

WALL- W6H

Nos. REQD. = 1 VOLUME 4.62 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



SECTION A-A

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

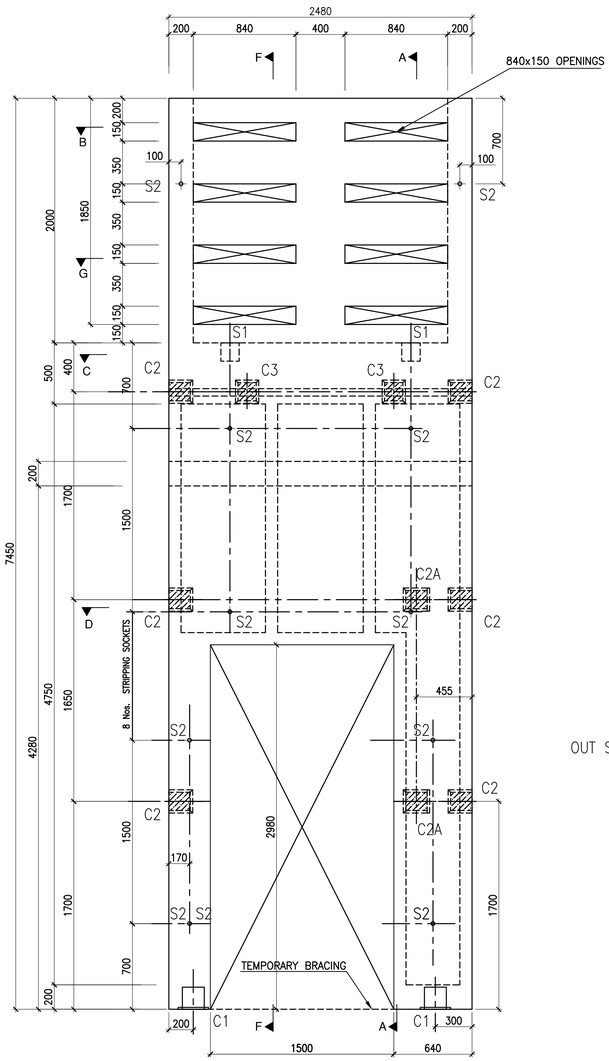
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

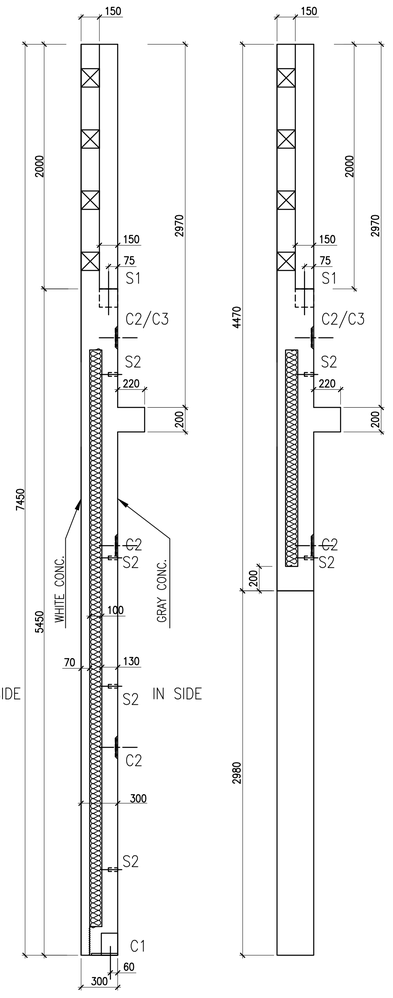
DRAWING NO.
RA140-32-BUI-CW-DW-65661-8

REV.
C1

A0(841x1189mm +2mm)

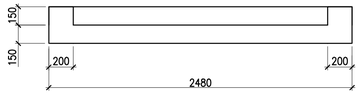


ELEVATION

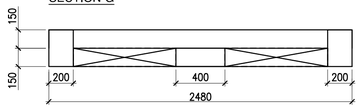


SECTION A-A

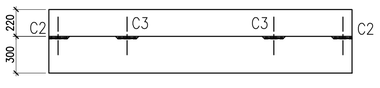
SECTION-F



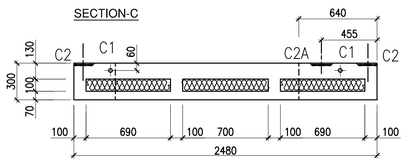
SECTION-G



SECTION-B



SECTION-C



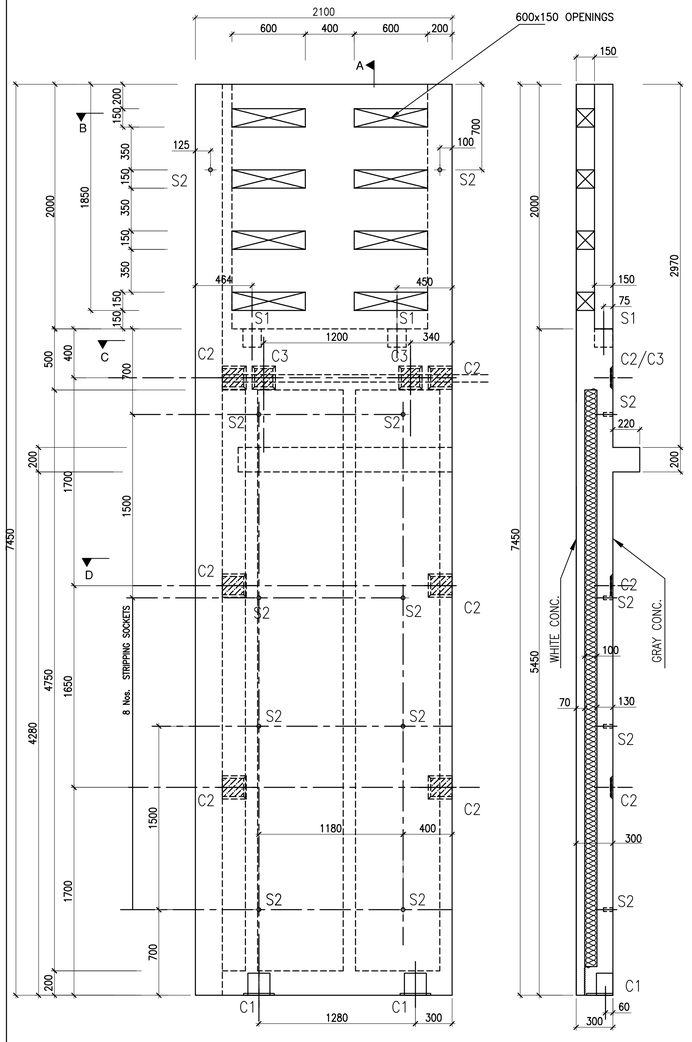
SECTION-D

WALL- W11

Nos. REQD. = 1 VOLUME 3.28 m³

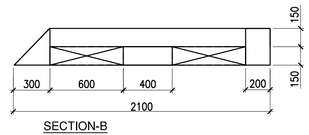
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A–2 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

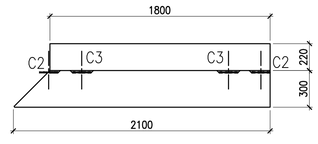


ELEVATION

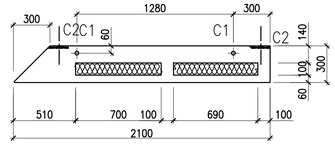
SECTION A-A



SECTION-B



SECTION-C



SECTION-D

WALL- W10H

Nos. REQD. = 1 VOLUME 3.52 m³

C1– 2 No CONNECTION
C2– 5 No CONNECTION
C3– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
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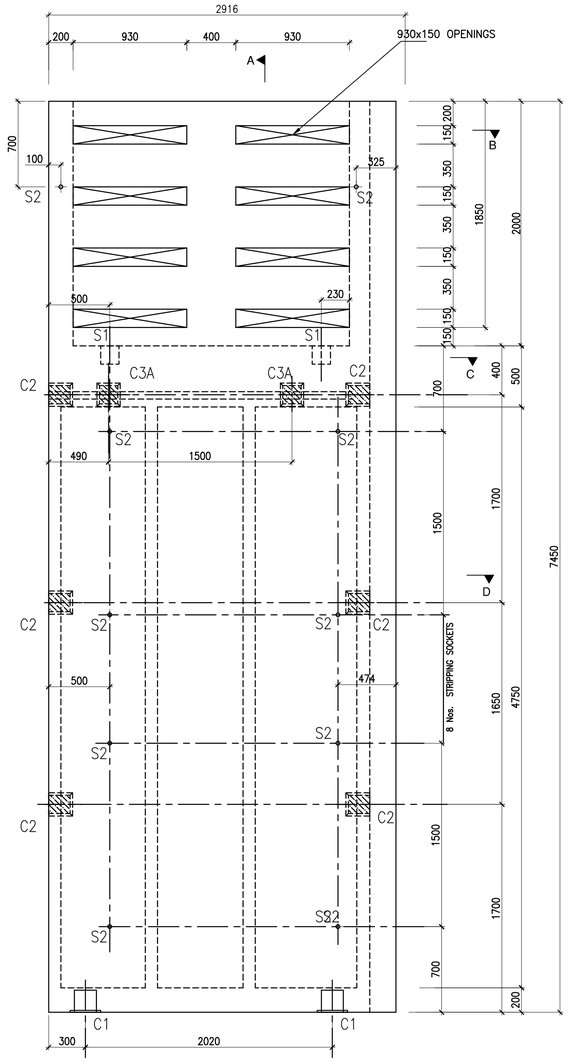
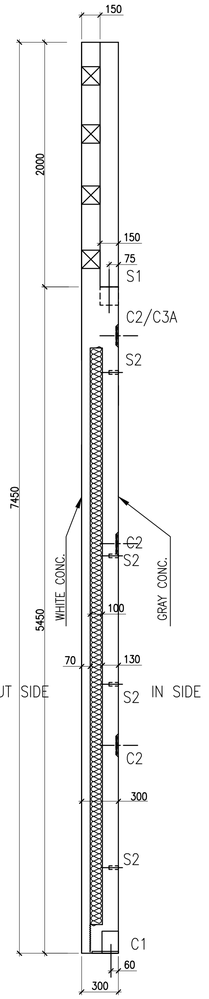
DRAWING NO. RA140-32-BUI-CW-DW-65661-9
REV. C1

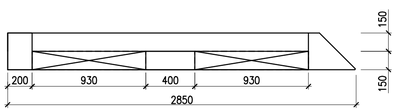
A0(841X1189mm +2mm)



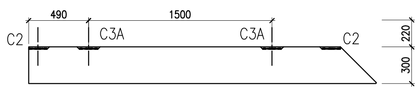
ELEVATION



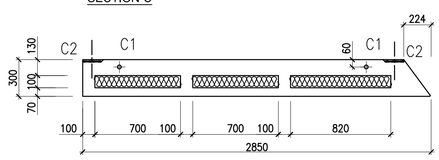
SECTION-A



SECTION-B



SECTION-C



SECTION-D

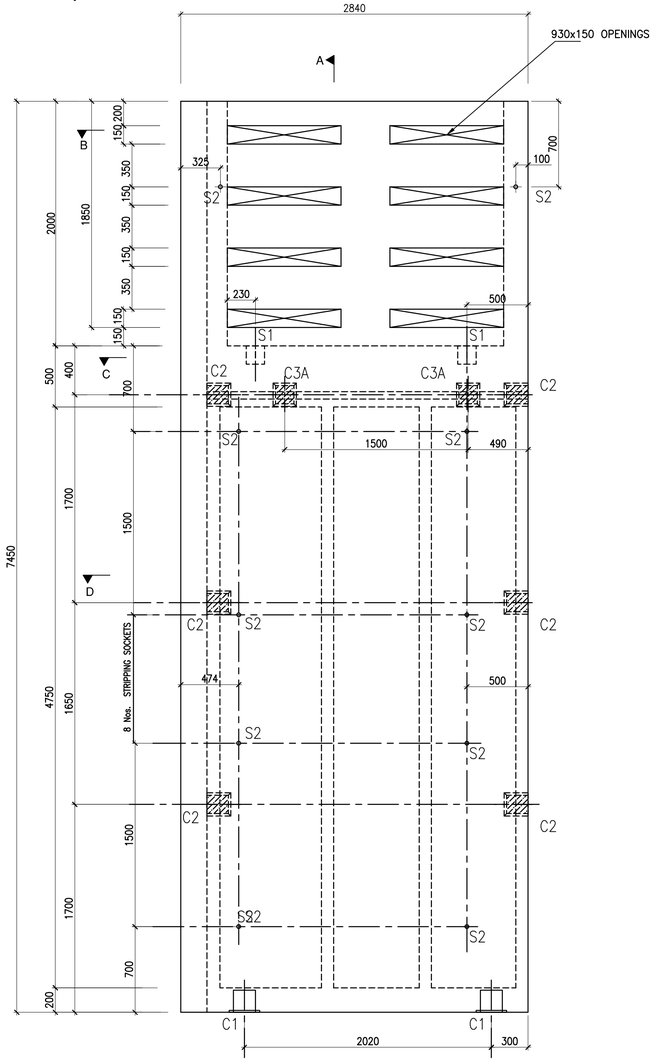
WALL- W12

Nos. REQD. = 2 VOLUME 4.20 m³

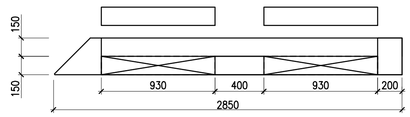
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION

S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

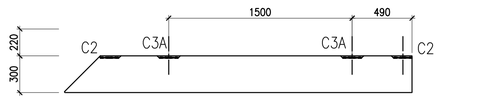
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001



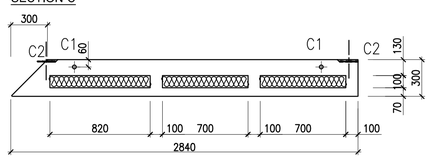
ELEVATION



SECTION-B



SECTION-C



SECTION-D

WALL- W12H

Nos. REQD. = 2 VOLUME 4.20 m³

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION

S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
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25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

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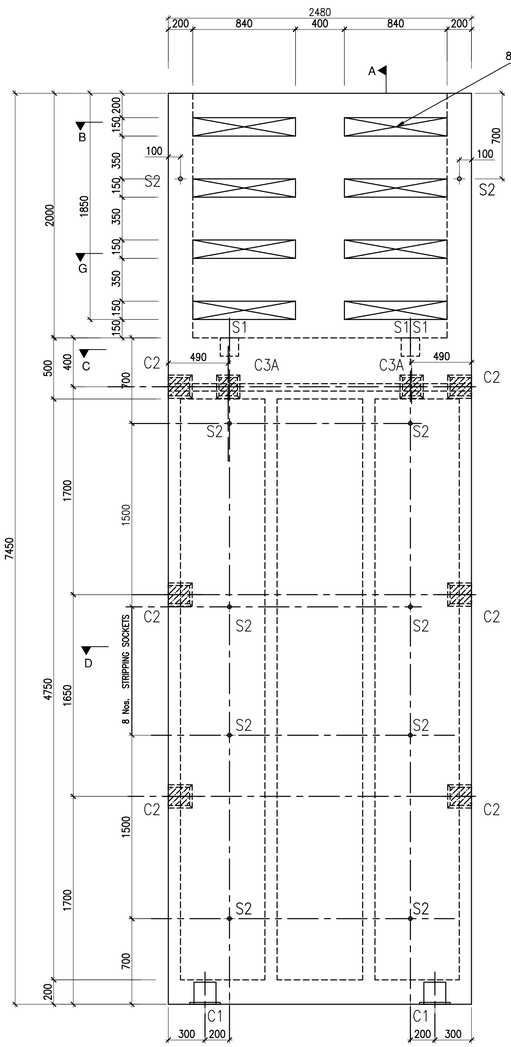
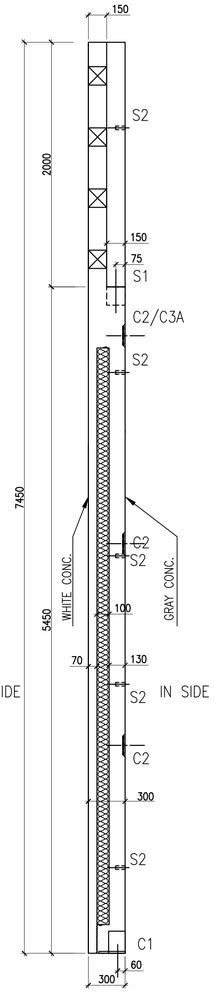
P.O.BOX 24476, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65661-10
REV. C1

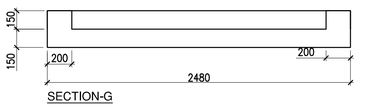
A0(841X1189mm +2mm)



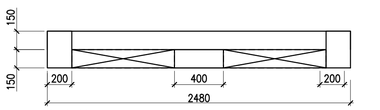
ELEVATION



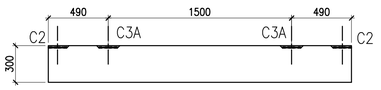
SECTION-A



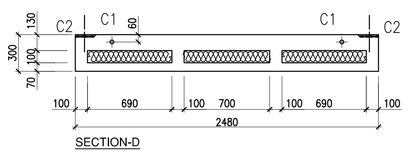
SECTION-G



SECTION-B



SECTION-C



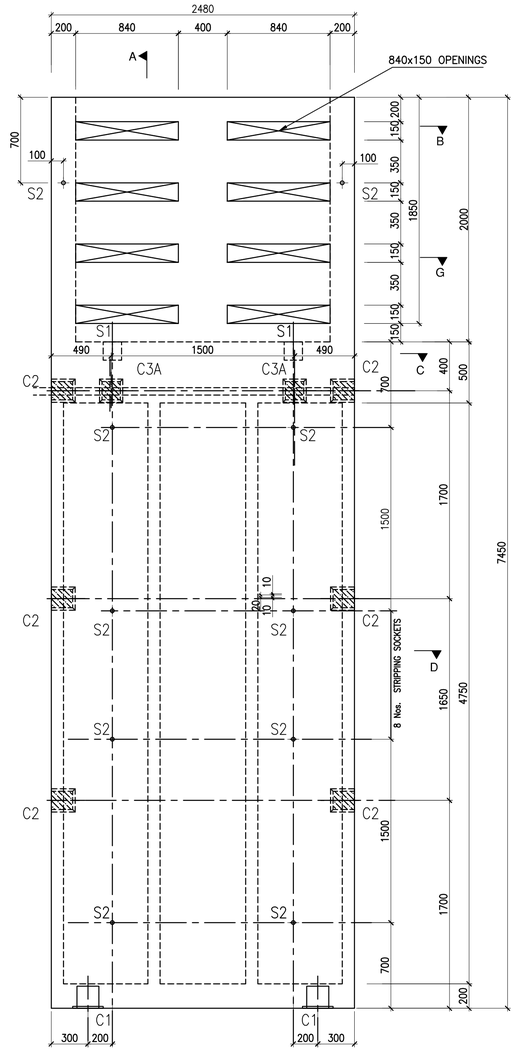
SECTION-D

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

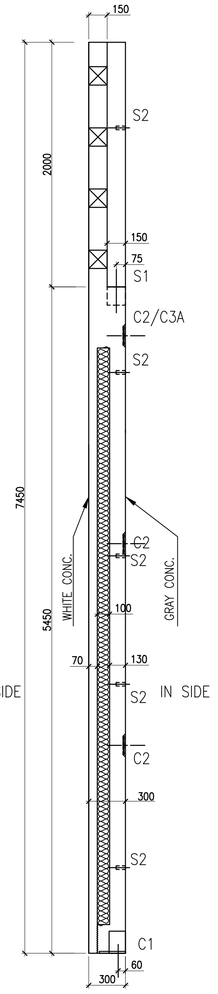
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W13

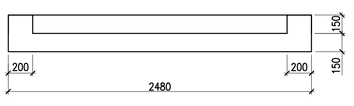
Nos. REQD. = 2 VOLUME 4.62 m³



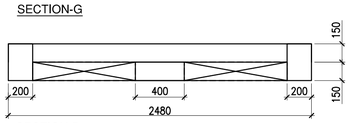
ELEVATION



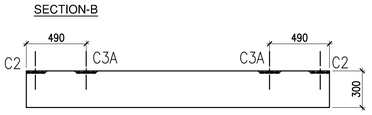
SECTION-A



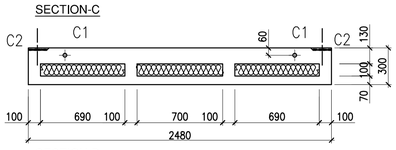
SECTION-G



SECTION-B



SECTION-C



SECTION-D

C1– 2 No CONNECTION
C2– 6 No CONNECTION
C3A– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W13H

Nos. REQD. = 1 VOLUME 4.62 m³

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

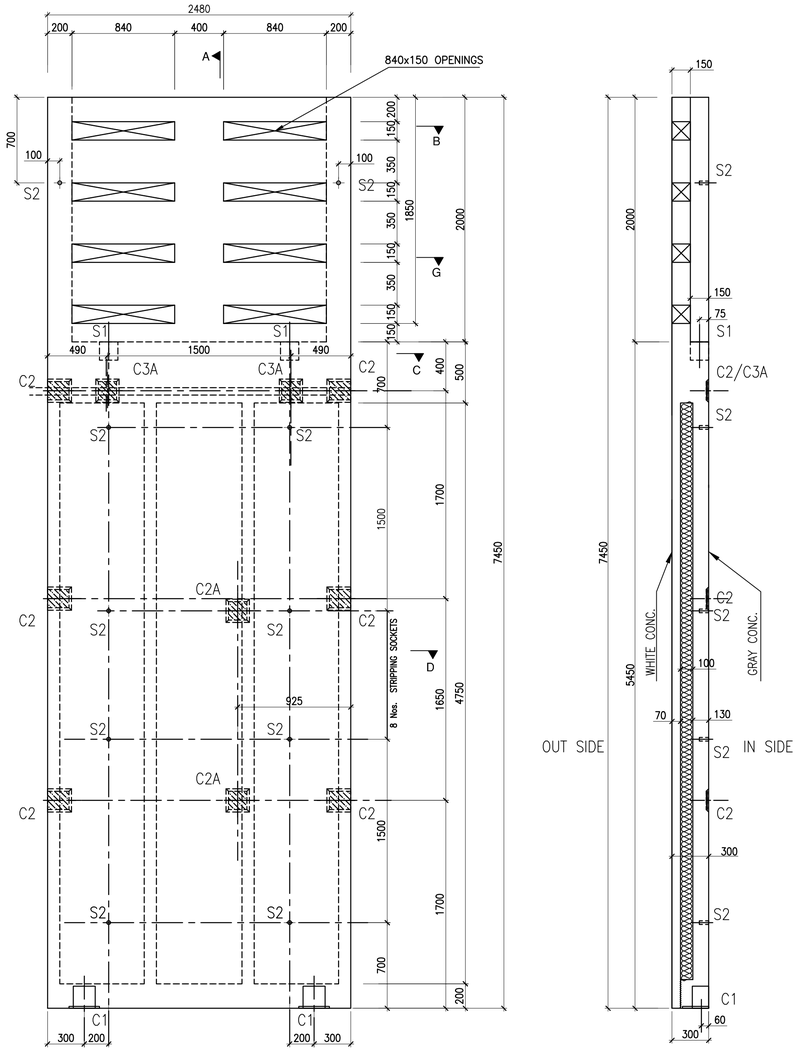
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

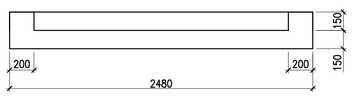
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

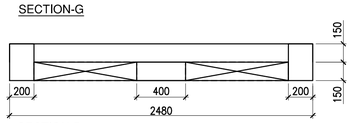
PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24476, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

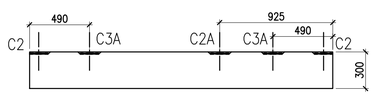
DRAWING NO. RA140-32-BUI-CW-DW-65661-11
REV. C1

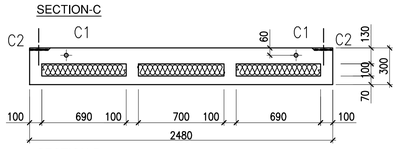
A0(841X1189mm +2mm)







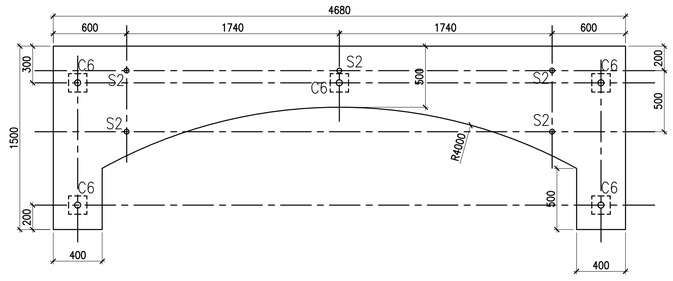




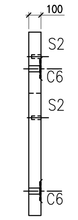
C1– 2 No CONNECTION
C2– 6 No CONNECTION
C2A– 2 No CONNECTION
C3A– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 10 No STRIPPING SOCKETS

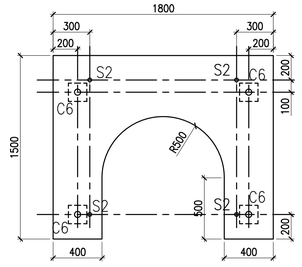
NOTE
FOR REINFORCEMENT DETAILS
REFER DWG.No. STUW–001

WALL- W13AH
Nos. REQD. = 1 VOLUME 4.62 m³



ARCH UNIT - P1





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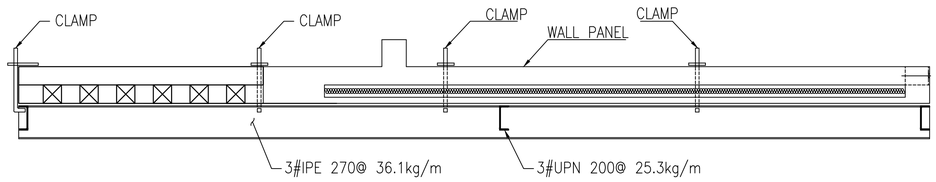
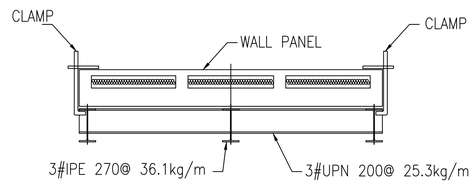


LONGITUDINAL SECTION



CROSS- SECTION

STEEL FRAME FOR TILTING WALL UNITS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE I (GREY) CEMENT EX MOULD.
CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 200 kg/cm²
REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²
COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

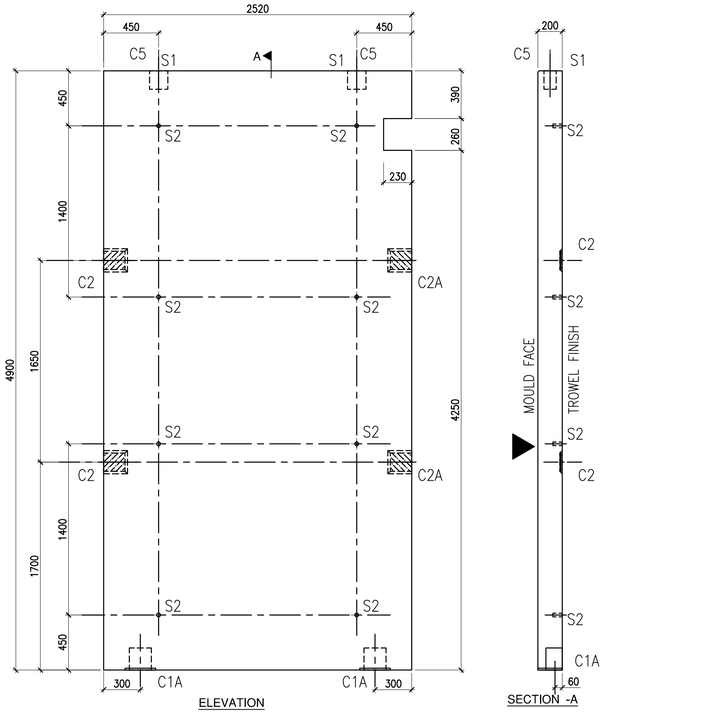
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

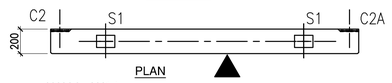
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24476, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65661-12
REV. C1

A0(841X1189mm +2mm)

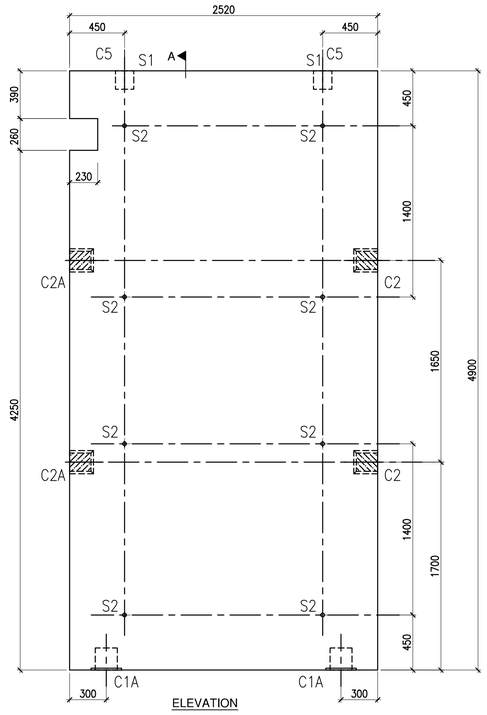


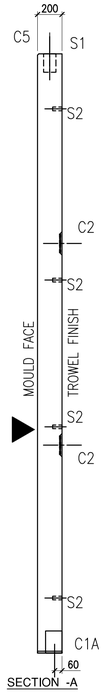


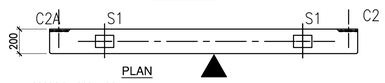
WALL- W14

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS



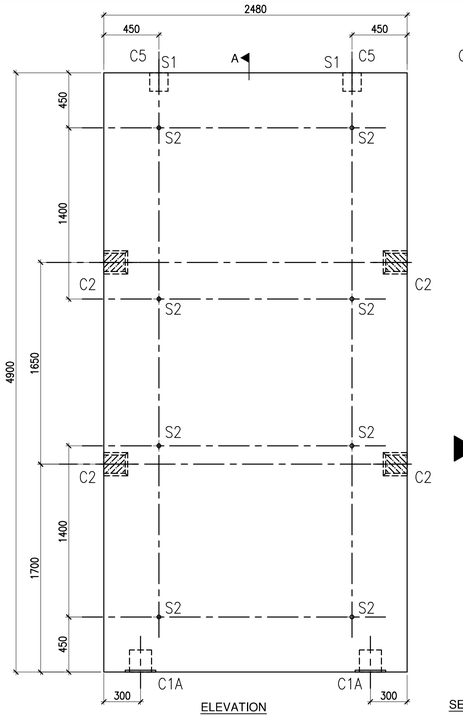


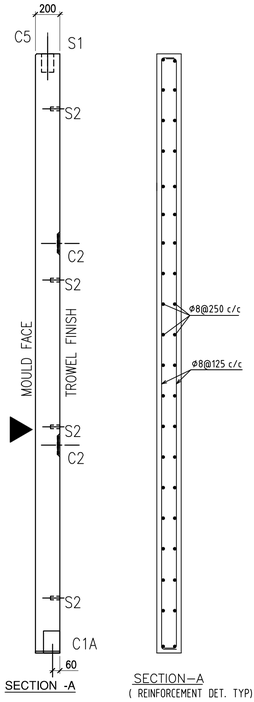


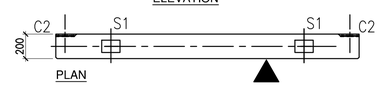
WALL- W14H

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS







WALL- W15 Nos. REQD. = 2

WALL- W17 Nos. REQD. = 3

VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

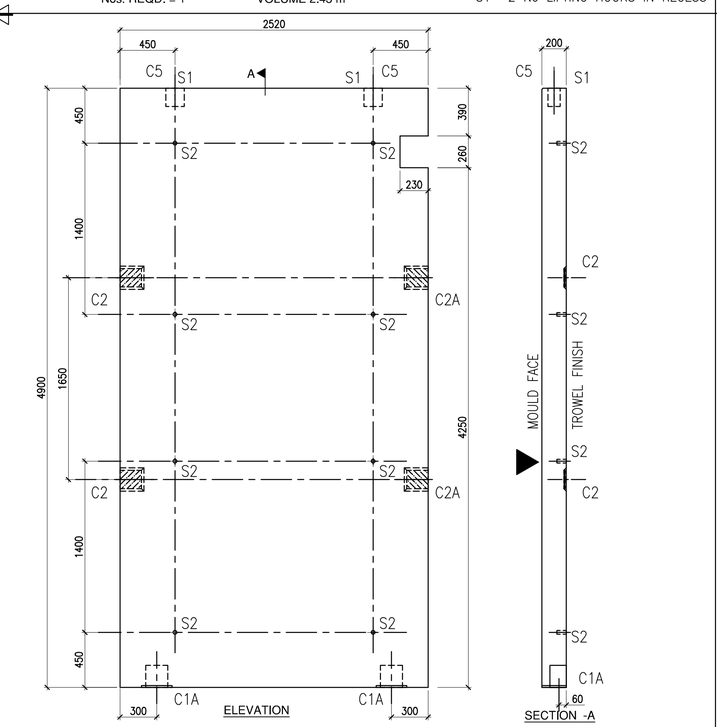
SPECIFICATIONS

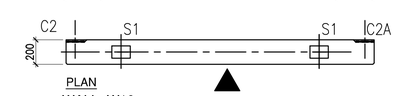
FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

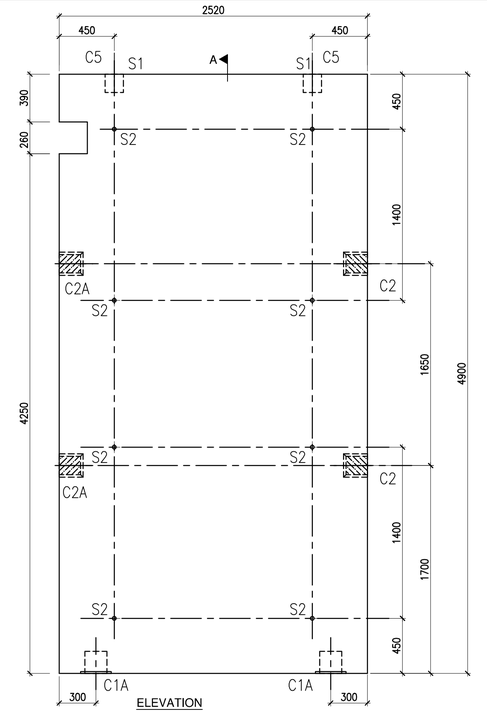




WALL- W16

Nos. REQD. = 2 VOLUME 2.43 m³

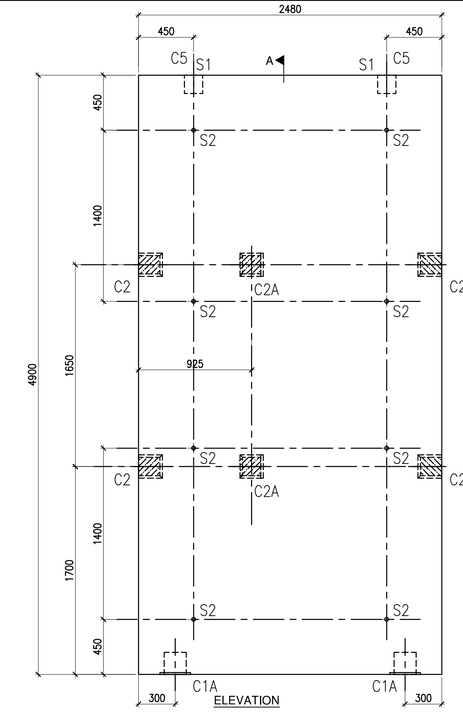
C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS

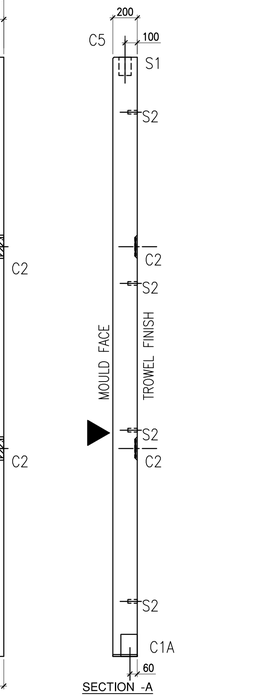


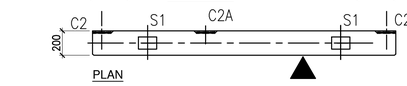
WALL- W16H

Nos. REQD. = 2 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS







WALL- W17A

Nos. REQD. = 1 VOLUME 2.43 m³

C1A– 2 No CONNECTION
C2– 4 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S2– 8 No STRIPPING SOCKETS
S1– 2 No LIFTING HOOKS IN RECESS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

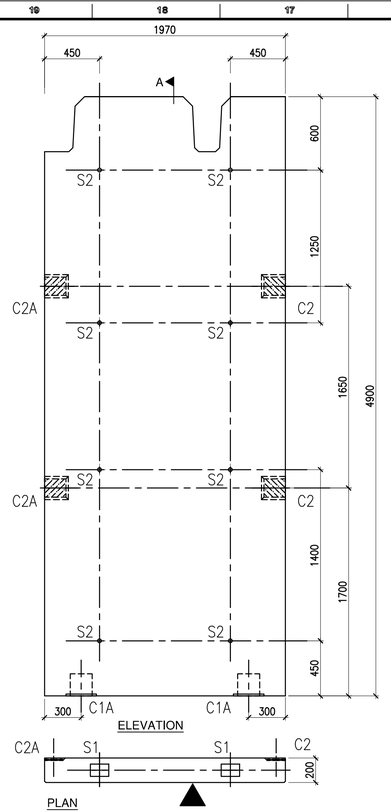
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL:23260054, FAX :23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65661-13

REV. C1

AO(841X1189mm +2mm)

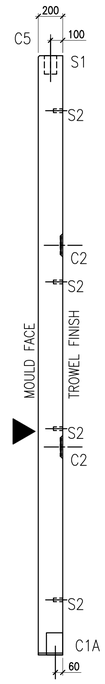


ELEVATION

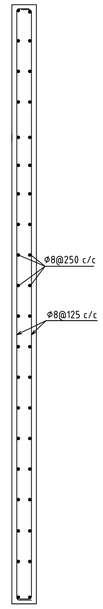
PLAN

WALL- W18

Nos. REQD. = 1 VOLUME 1.93 m³

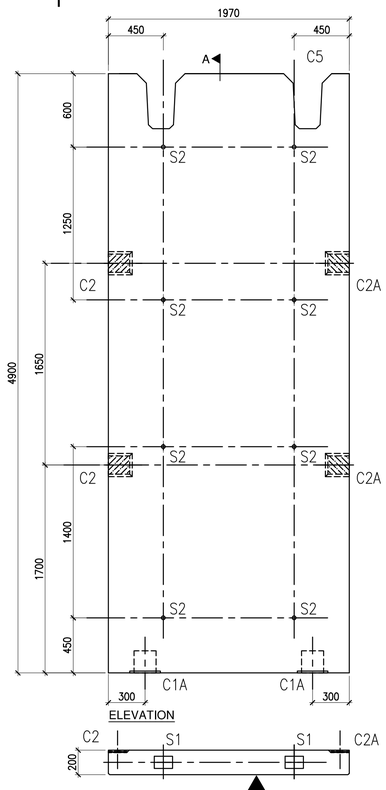


SECTION -A



SECTION–A
(REINFORCEMENT DET. TYP)

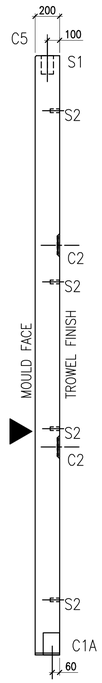
C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS



ELEVATION

WALL- W18H

Nos. REQD. = 1 VOLUME 1.93 m³



SECTION -A

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

SPECIFICATIONS

FINISH
WHITE CEMENT, SAND BLAST FINISH AS NOTED & TYPE V CEMENT EX MOULD.

CONCRETE CUBE STRENGTH
AT 28 DAYS = 350 kg/cm²
STRIPPING = 150 kg/cm²

REINFORCING STEEL
AS PER ASTM A-615 GRADE 60 WITH MINIMUM YIELD STRENGTH OF 4200 kg/cm²

COVER
50 mm FOR FOOTINGS
25 mm FOR COLUMN NECK
30 mm FOR WALL PANELS

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER
STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE
SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE
ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
WALL UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

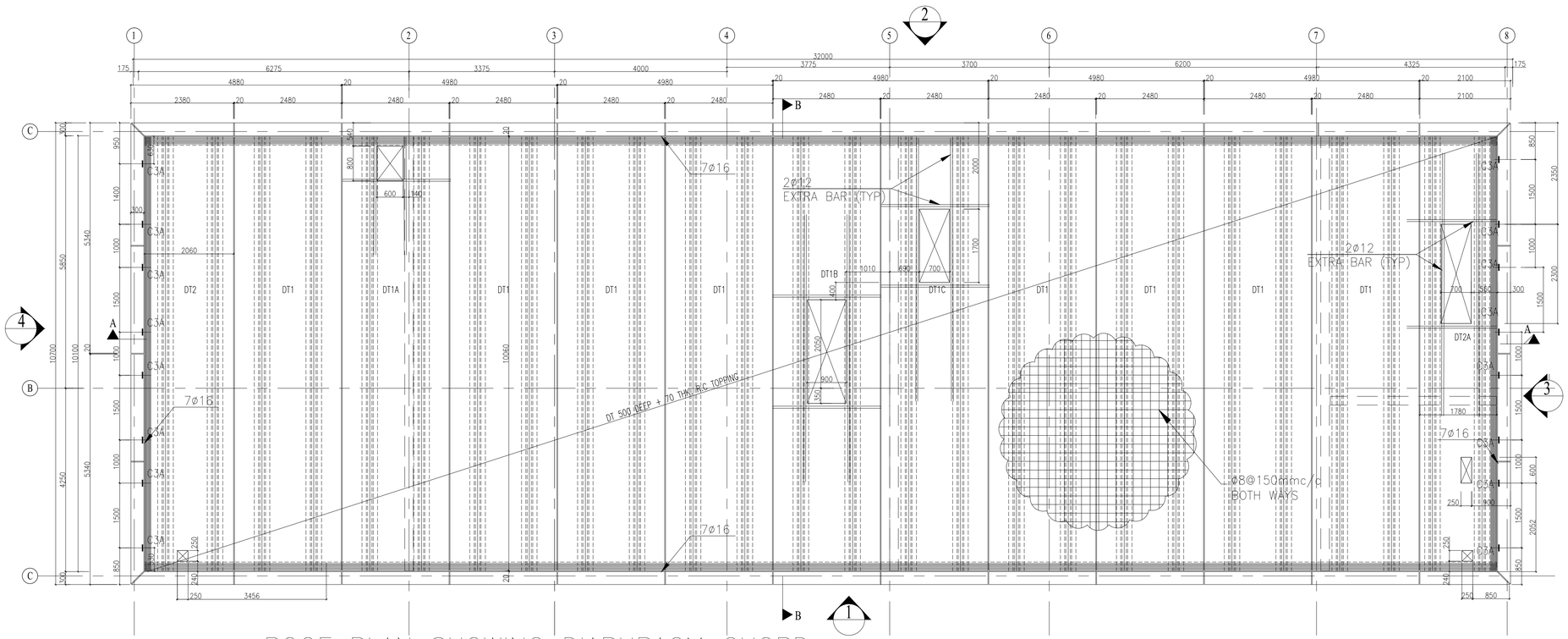
CONTRACTOR
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

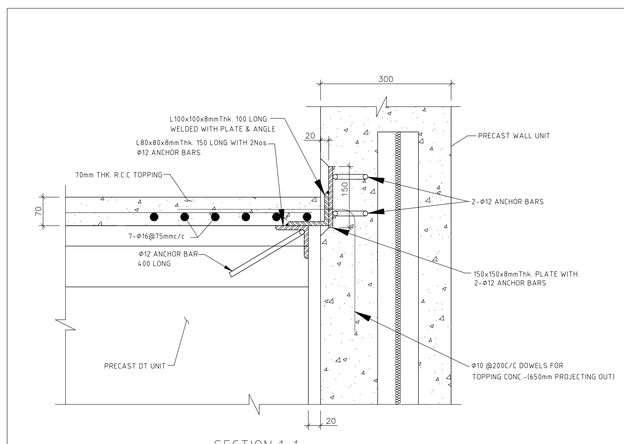
DRAWING NO.
RA140-32-BUI-CW-DW-65661-14

REV.
C1

A0(841X1189mm +2mm)

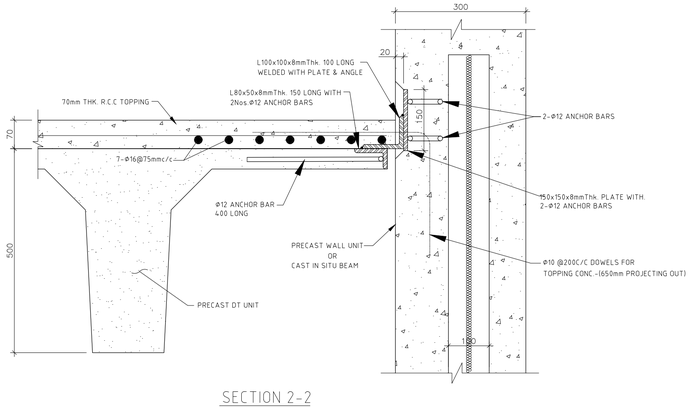


ROOF PLAN SHOWING DIAPHRAGM CHORD



SECTION 1-1

SECTION SHOWING `DT' TO WALL CONNECTION



SECTION 2-2

SECTION SHOWING `DT' TO WALL CONNECTION

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE SOUTH ISLAND SUBSTATION BSS 2 ROOF PLAN (R/F . IN STRUCTURAL TOPPING CONCRETE)

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

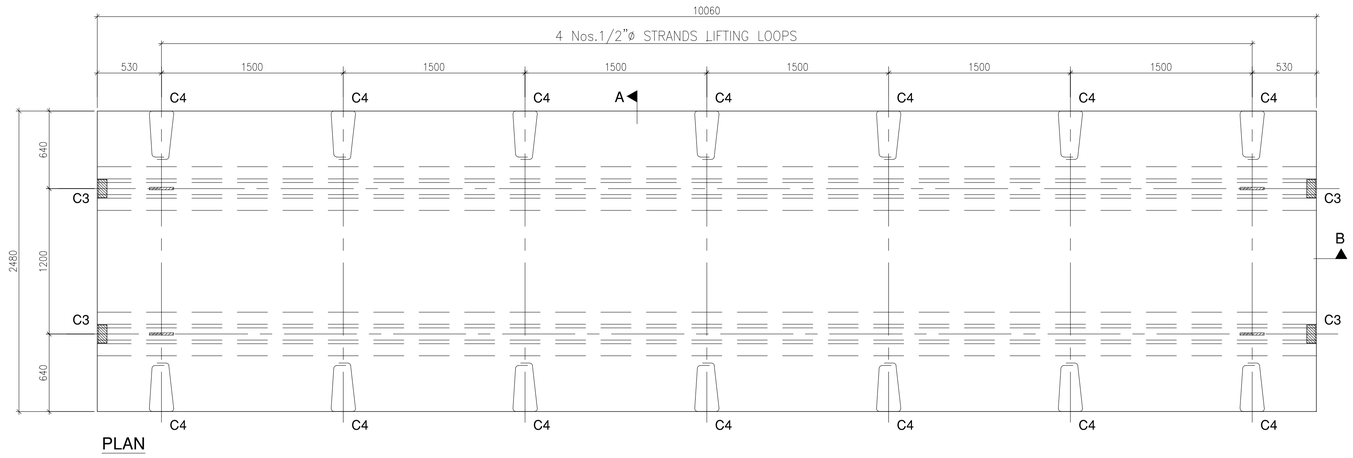
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

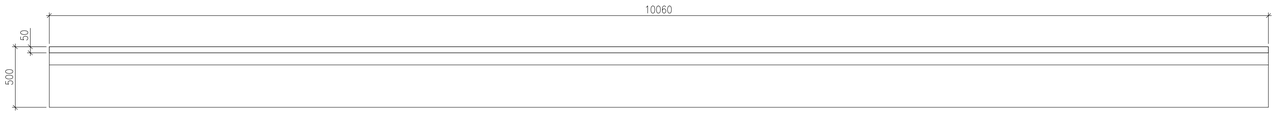
DRAWING NO. RA140-32-BUI-CW-DW-65662

REV. C1

A0(841X1197mm +2mm)



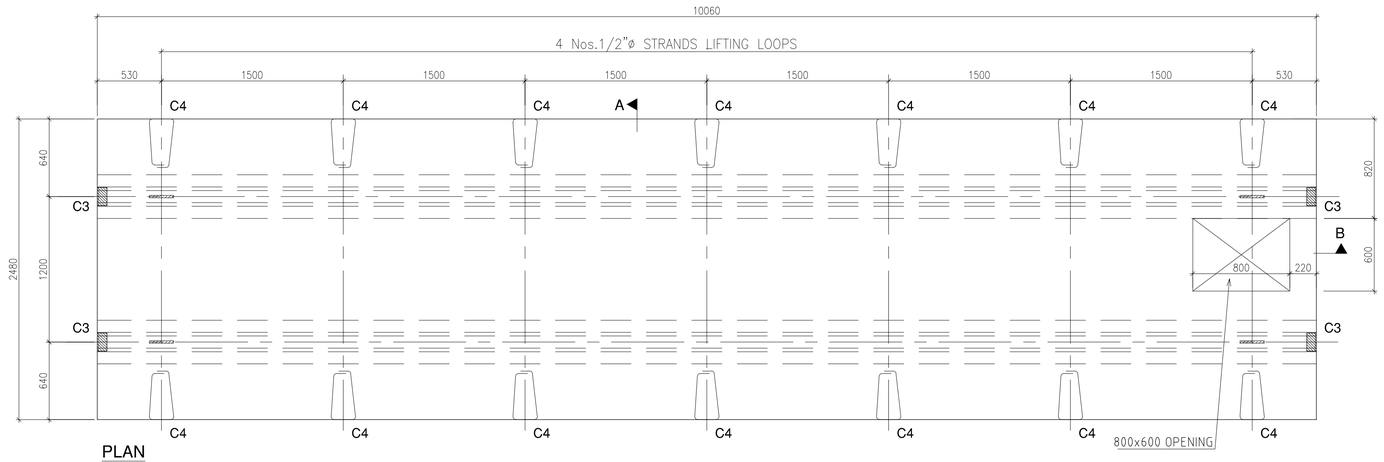
PLAN



SECTION - B

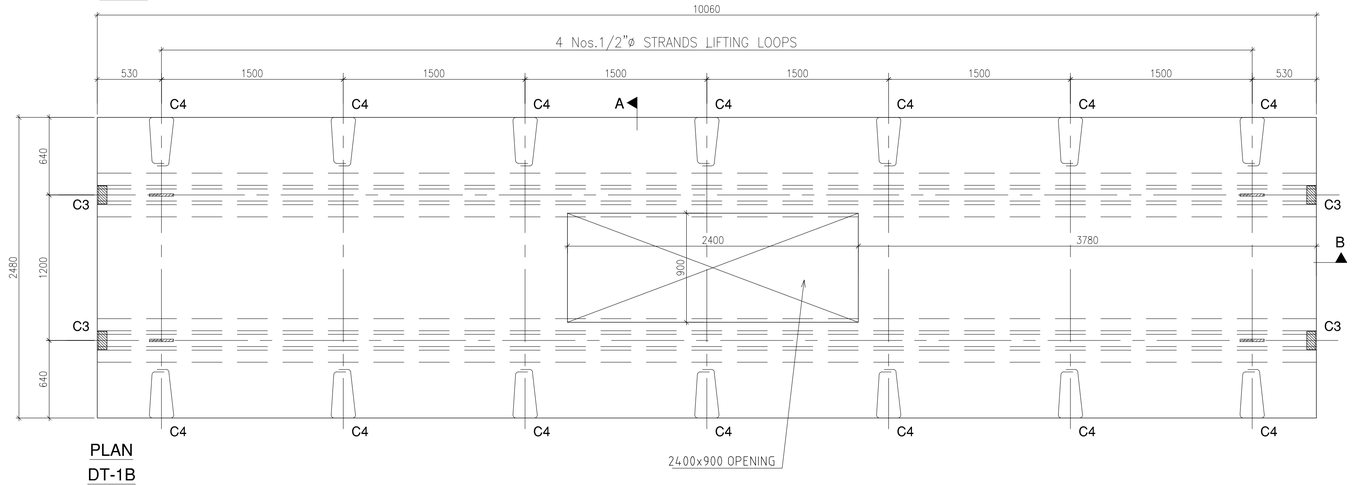
DT-1

Nos. REQD. = 8



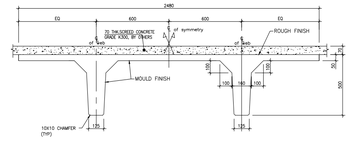
PLAN

DT-1A



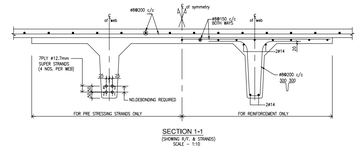
PLAN

DT-1B



SECTION - A

(SHOWING DIMENSIONS)



SECTION 1-1

(SHOWING 4/5 & 5 STRANDS)

SCALE - 1:10

PRECAST CONCRETE 'DT500' STANDARD

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CLEAR COVER TO REINFORCEMENT = 20mm (MINIMUM).
3. LAP LENGTH OF REINFORCING BAR IS 65 TIMES DIA. OF LESSER DIAMETER OF BAR.
4. CUBE STRENGTH OF CONCRETE AT 28 DAYS = 50N/mm² FOR PRECAST PRESTESSED 'DT' UNITS.
5. CYLINDER STRENGTH OF CONCRETE AT TRANSFER OF PRESTRESS =35 N/mm² (INTERNAL DATA FOR PRECAST PLANT).
6. STRUCTURAL INSITU CONCRETE SCREED 70mm THICK MINIMUM AND 28 DAYS STRENGTH = 35N/mm².
7. STRANDS 12.7mm DIA. TO ASTM A 416/74.
8. HIGH YIELD STRENGTH DEFORMED BAR fy NOT LESS THAN 420MPa (INDICATED THUS ø) TO ASTM A615 STANDARD
9. CEMENT TYPE – 1 (OPC).
10. JACKING FORCE PER STRAND =134.00KN.
11. ULTIMATE BREAKING LOAD PER STRAND = 186 KN.
12. FACTOY FINISH = EX-MOULD FINISH AND AS SHOWN.
13. ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL (ASTM A36 RED OXIDE PAINTED).

REV.	DATE	DESCRIPTION OF REVSION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
DT UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

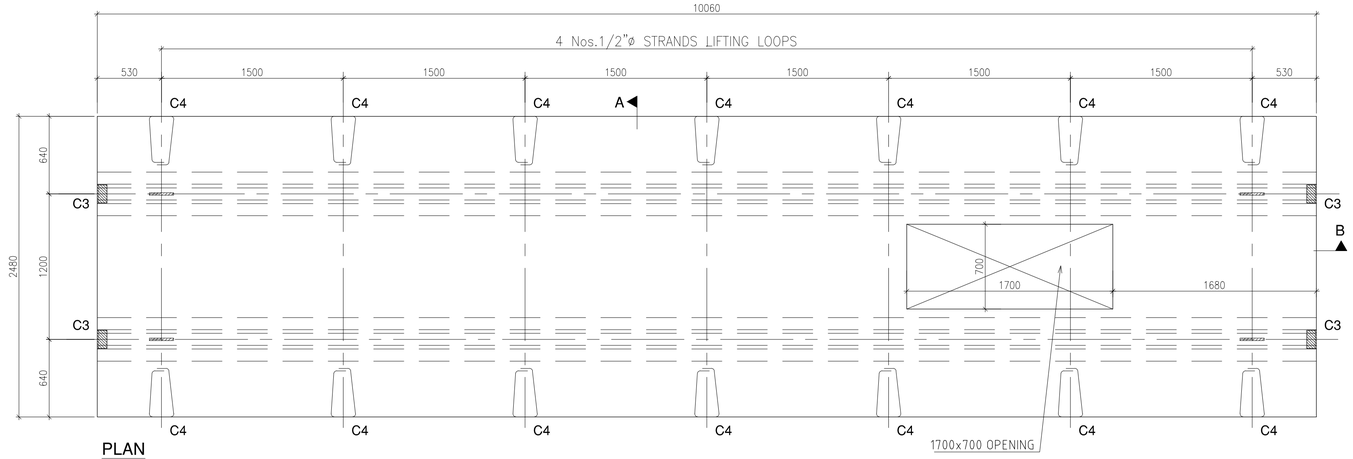
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO

P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO. RA140-32-BUI-CW-DW-65663-1

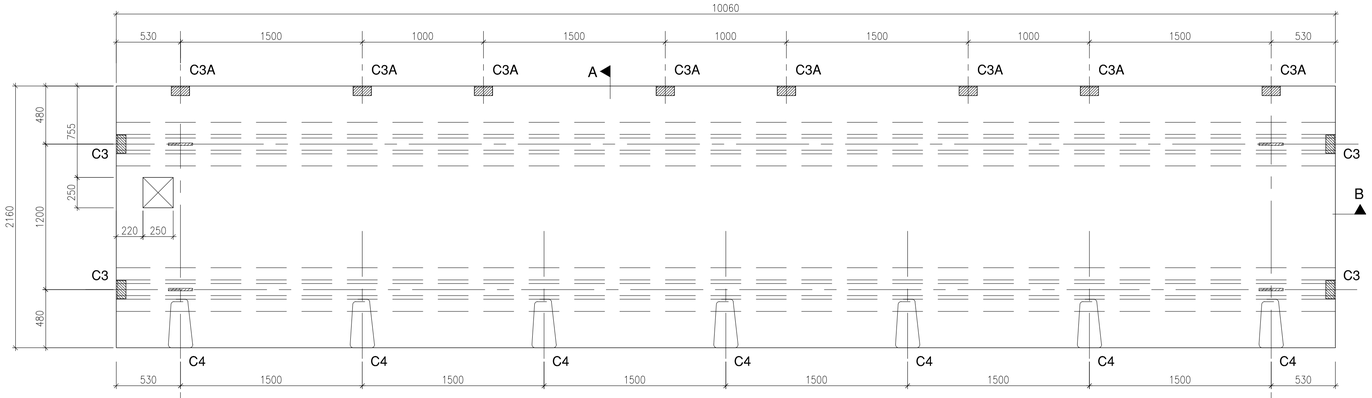
REV. C1

A0(841x1189mm +2mm)



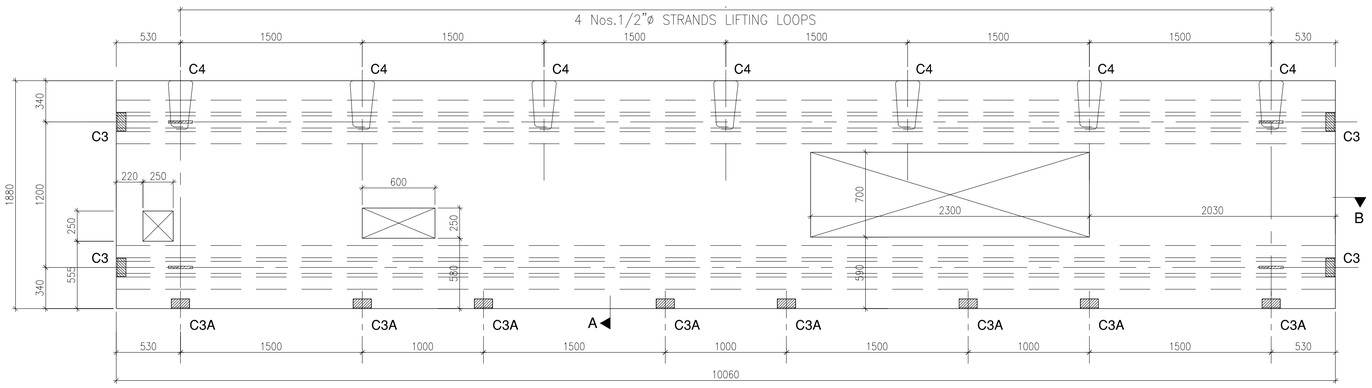
PLAN

DT-1C



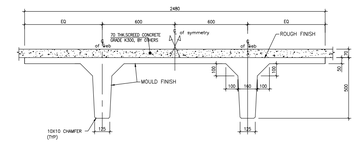
PLAN

DT-2



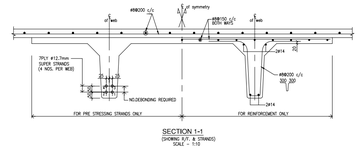
DT-2A

PLAN



SECTION - A

(SHOWING DIMENSIONS)



SECTION 1-1

(SHOWING R/F & STRANDS)

SCALE - 1:10

PRECAST CONCRETE 'DT500' STANDARD

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CLEAR COVER TO REINFORCEMENT = 20mm (MINIMUM).
3. LAP LENGTH OF REINFORCING BAR IS 65 TIMES DIA. OF LESSER DIAMETER OF BAR.
4. CUBE STRENGTH OF CONCRETE AT 28 DAYS = 50N/mm² FOR PRECAST PRESTESSED 'DT' UNITS.
5. CYLINDER STRENGTH OF CONCRETE AT TRANSFER OF PRESTRESS =35 N/mm² (INTERNAL DATA FOR PRECAST PLANT).
6. STRUCTURAL INSITU CONCRETE SCREED 70mm THICK MINIMUM AND 28 DAYS STRENGTH = 35N/mm².
7. STRANDS 12.7mm DIA. TO ASTM A 416/74.
8. HIGH YIELD STRENGTH DEFORMED BAR fy NOT LESS THAN 420MPa (INDICATED THUS ø) TO ASTM A615 STANDARD
9. CEMENT TYPE – I (OPC).
10. JACKING FORCE PER STRAND =134.00KN.
11. ULTIMATE BREAKING LOAD PER STRAND = 186 KN.
12. FACTOY FINISH = EX-MOULD FINISH AND AS SHOWN.
13. ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL (ASTM A36 RED OXIDE PAINTED).

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
DT UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

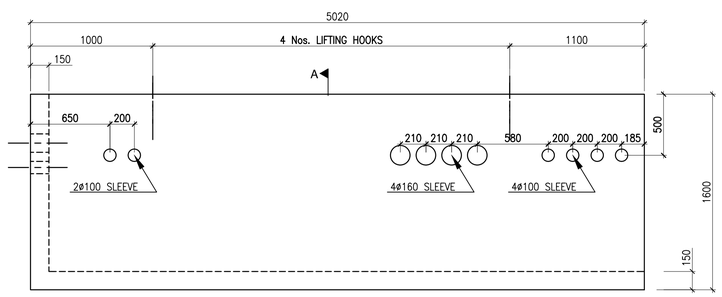
PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

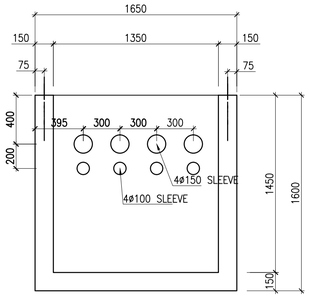
DRAWING NO. RA140-32-BUI-CW-DW-65663-2

REV. C1

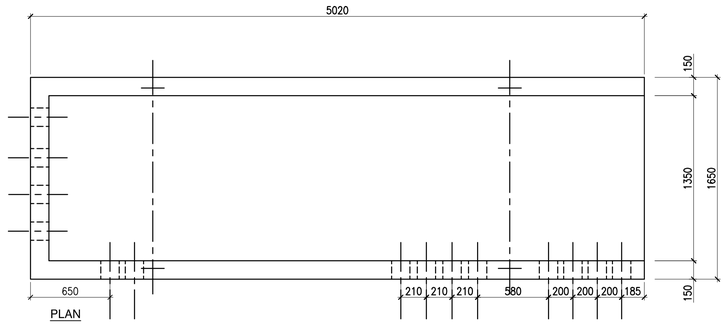
A0(841x1189mm +2mm)



ELEVATION



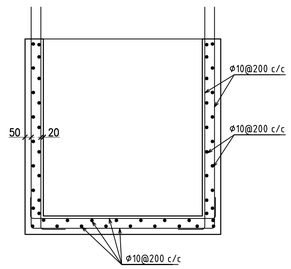
SECTION - A



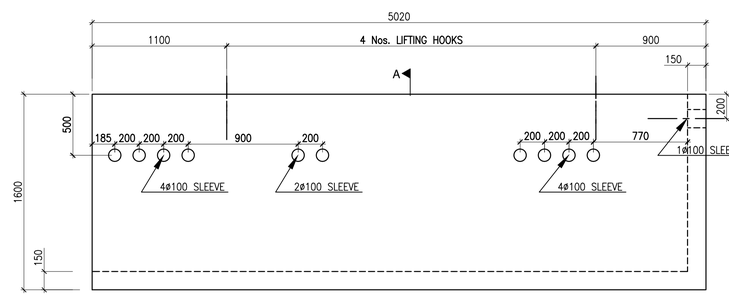
PLAN

TRENCH - TR1

Nos. REQD. = 1



SECTION-A
SHOWING REINF.



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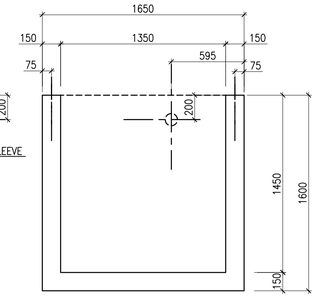
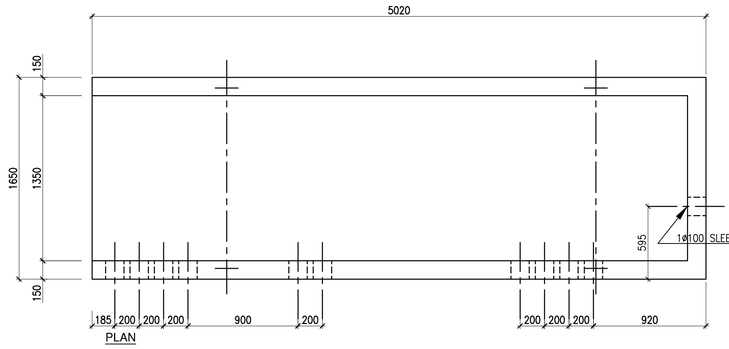


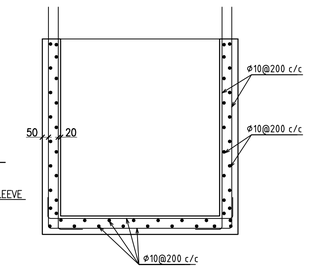
SECTION - A



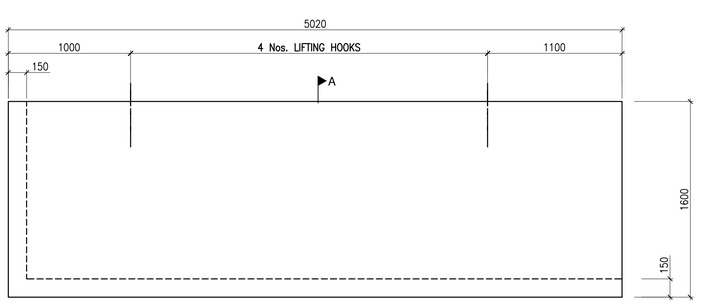
PLAN

TRENCH - TR1H

Nos. REQD. = 1



SECTION-A
SHOWING REINF.



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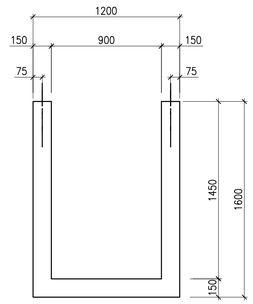
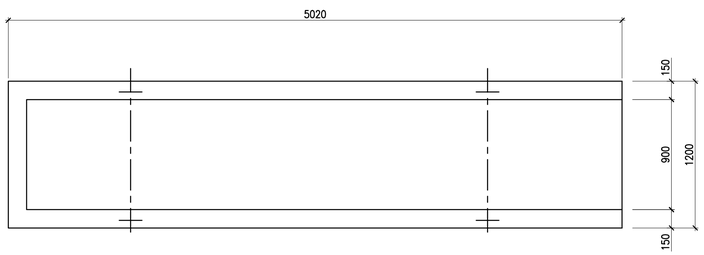


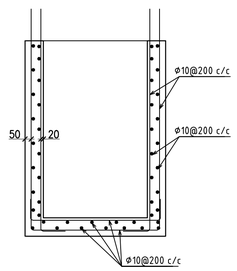
SECTION - A



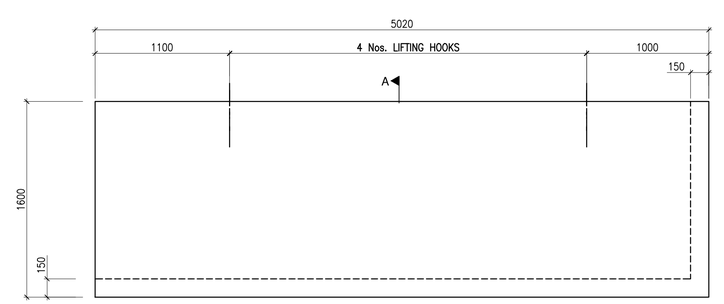
PLAN

TRENCH - TR2

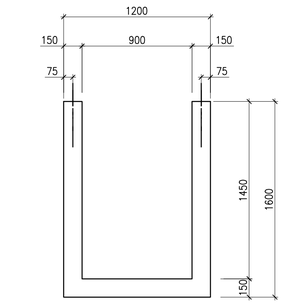
Nos. REQD. = 2



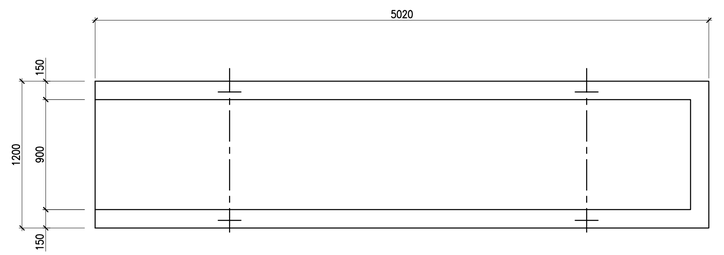
SECTION-A
SHOWING REINF.



ELEVATION



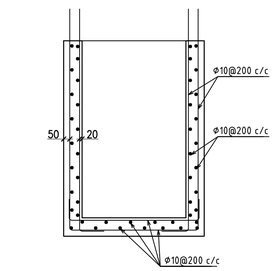
SECTION - A



PLAN

TRENCH - TR2H

Nos. REQD. = 1



SECTION-A
SHOWING REINF.

NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

PRECAST SUPPLIER

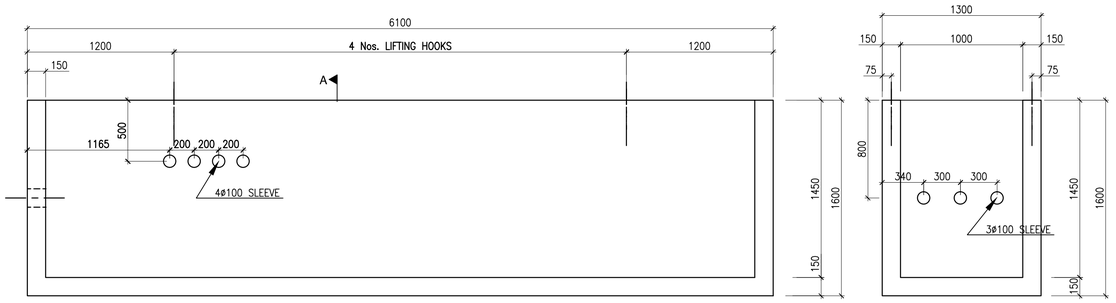
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

RA140-32-BUI-CW-DW-65664-1

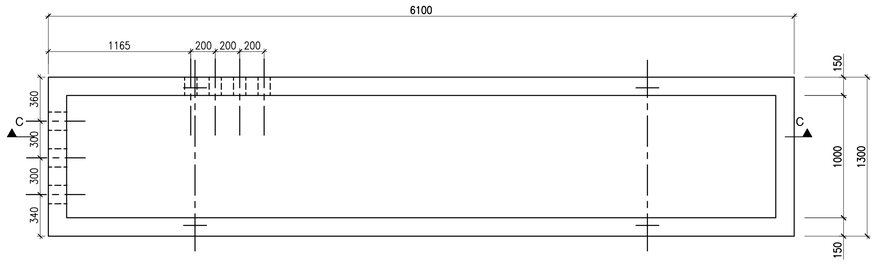
REV.

C1

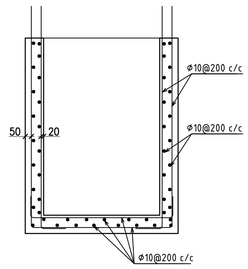


SECTION C-C

SECTION - A



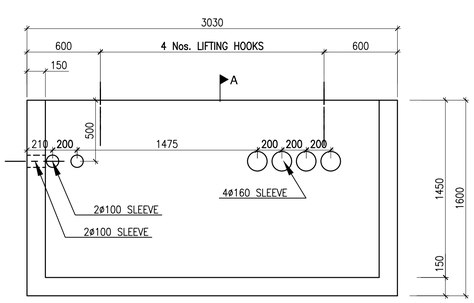
PLAN



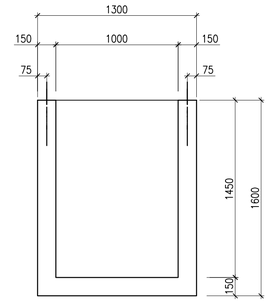
SECTION-A
SHOWING REINF.

TRENCH - TR3

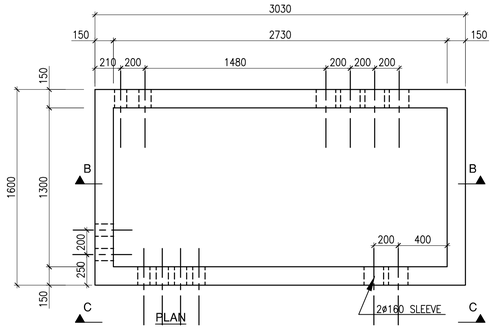
Nos. REQD. = 1



SECTION B-B



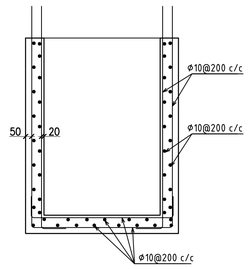
SECTION - A



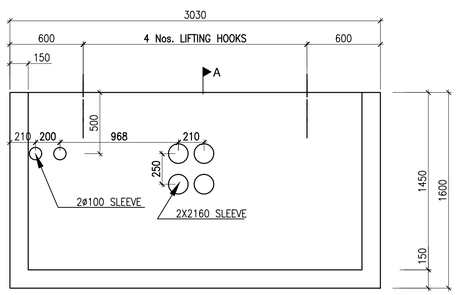
PLAN

TRENCH - TR4.1

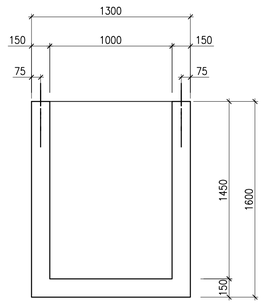
Nos. REQD. = 1



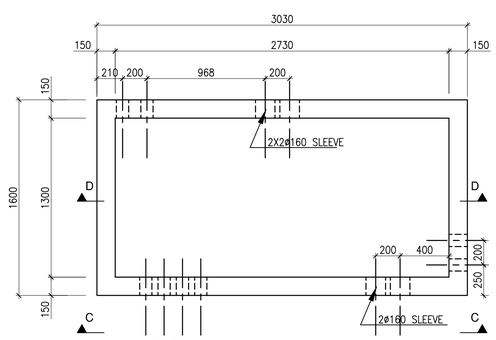
SECTION-A
SHOWING REINF.



SECTION D-D



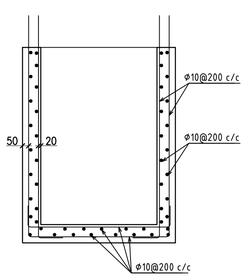
SECTION - A



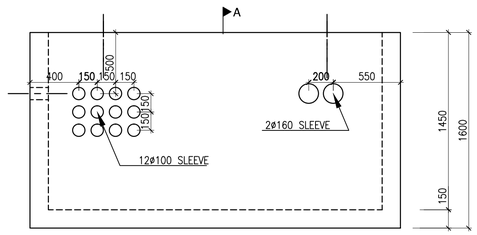
PLAN

TRENCH - TR4.2

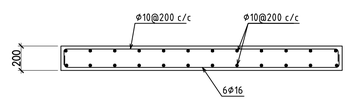
Nos. REQD. = 1



SECTION-A
SHOWING REINF.



ELEVATION C-C



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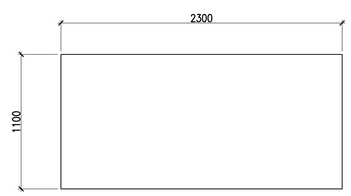


TRANSFORMER SUPPORT SLAB UNIT

Nos. REQD. = 4

NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION — Combined Group Contracting Company

PRECAST SUPPLIER

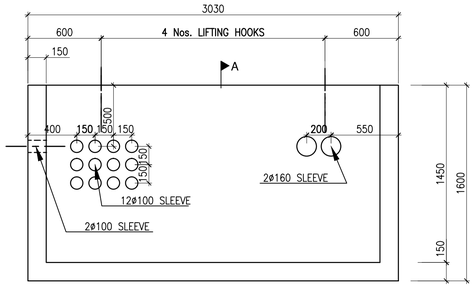
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

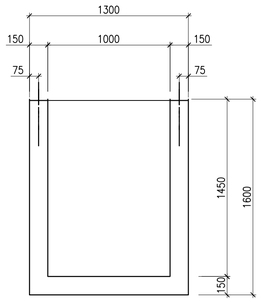
RA140-32-BUI-CW-DW-65664-2

REV.

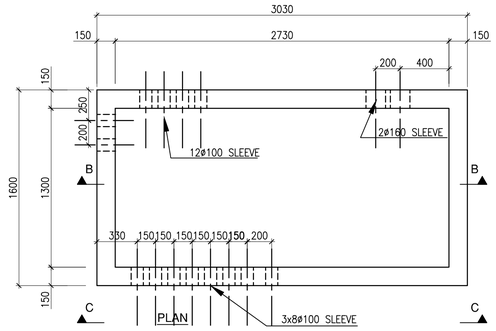
C1



SECTION B-B



SECTION - A



TRENCH - TR4.3

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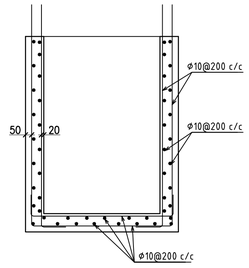

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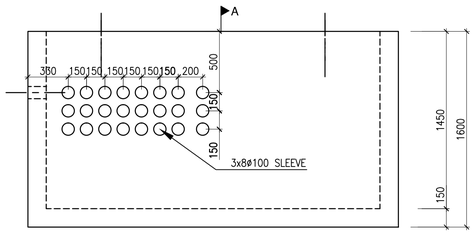

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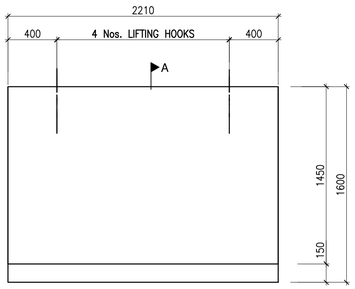

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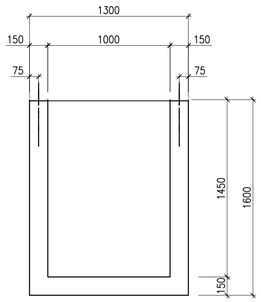

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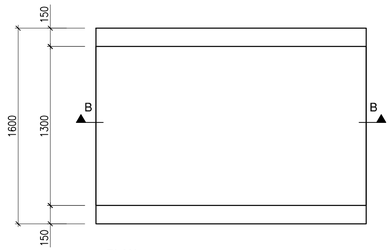

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TRENCH - TR5

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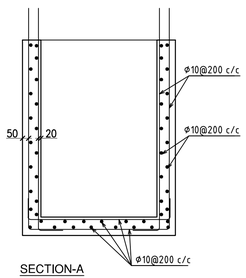

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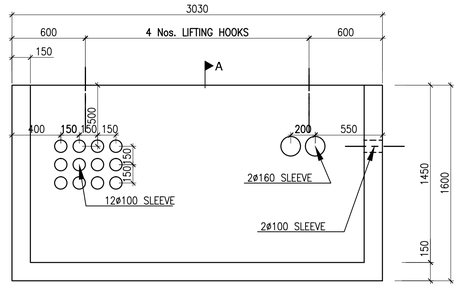

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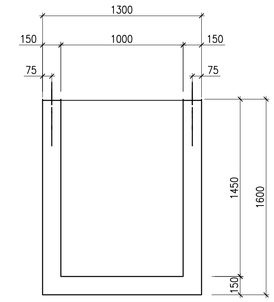

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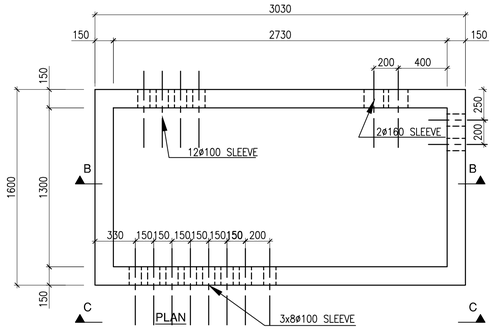

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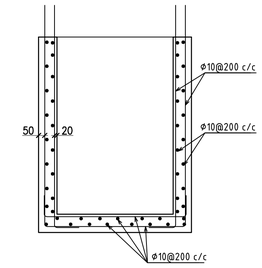

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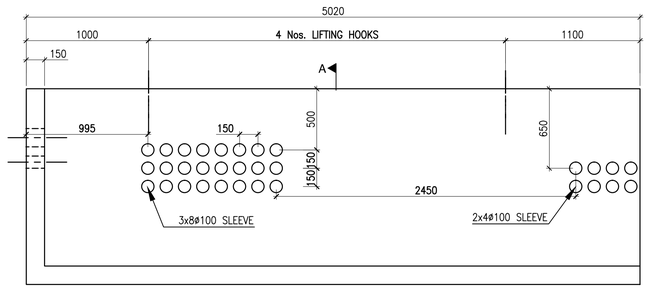

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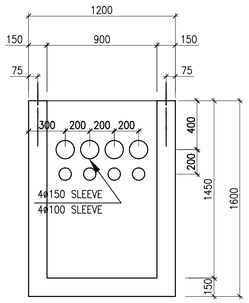

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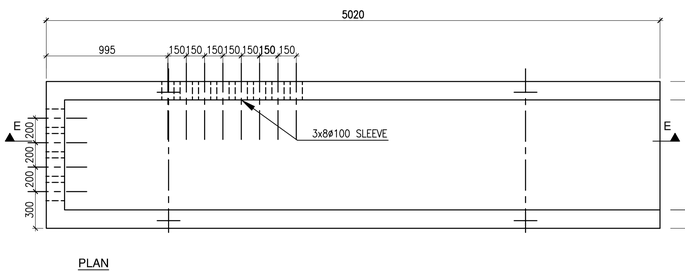

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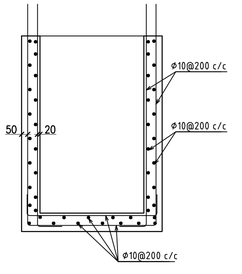

SECTION-A
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NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK) CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

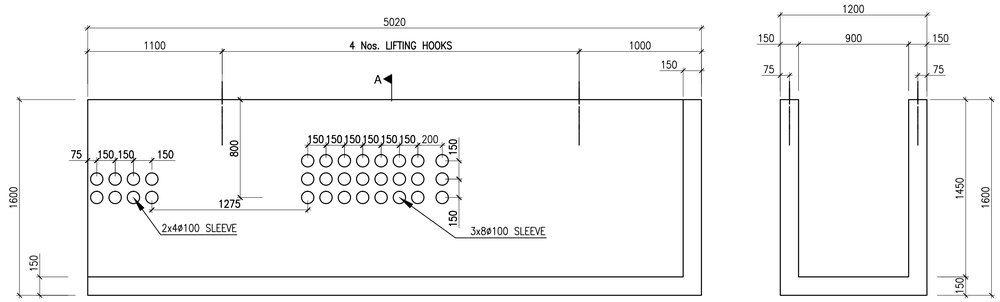
HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

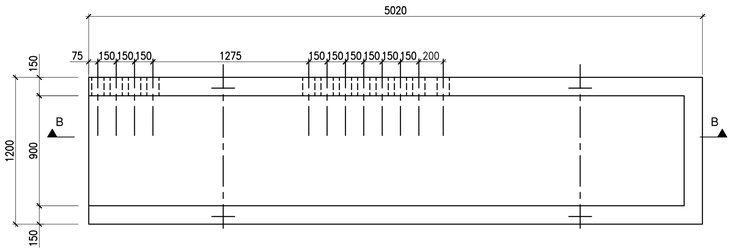
DRAWING NO. RA140-32-BUI-CW-DW-65664-3

REV. C1

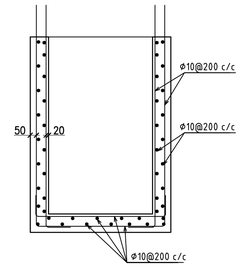


SECTION B-B

SECTION - A



PLAN



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TRENCH - TR2H

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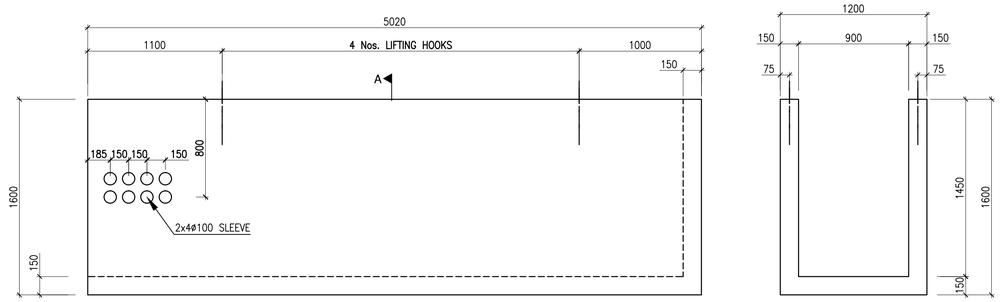

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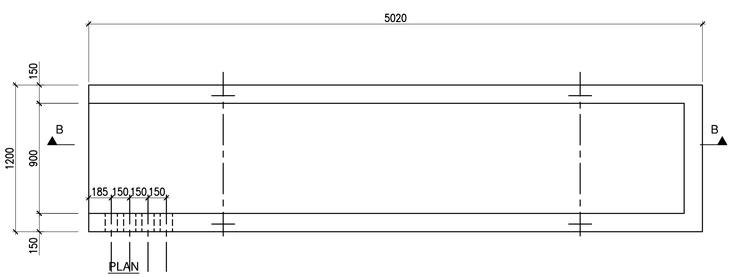

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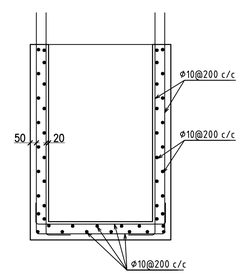

SECTION-A
SHOWING REINF.

TRENCH - TR2.2H

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NOTES

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TRENCH UNIT DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:25	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

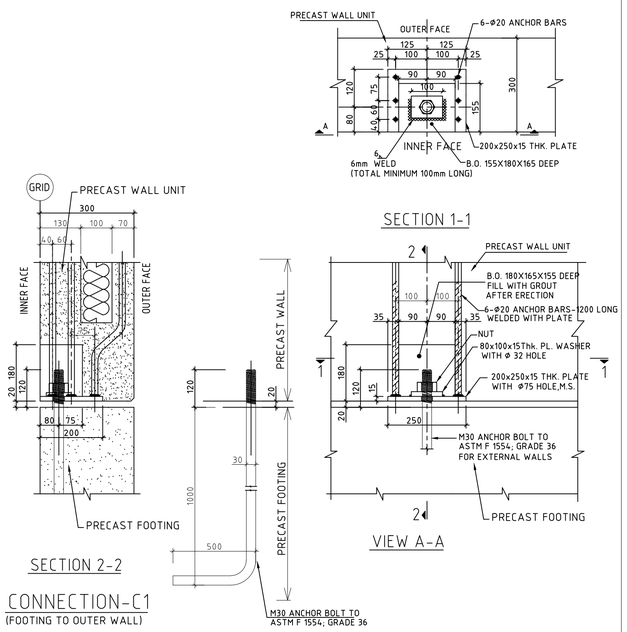
REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

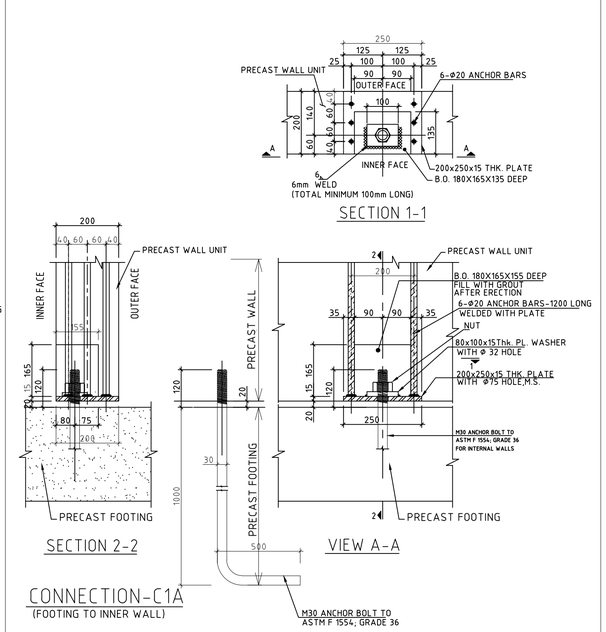
DRAWING NO.

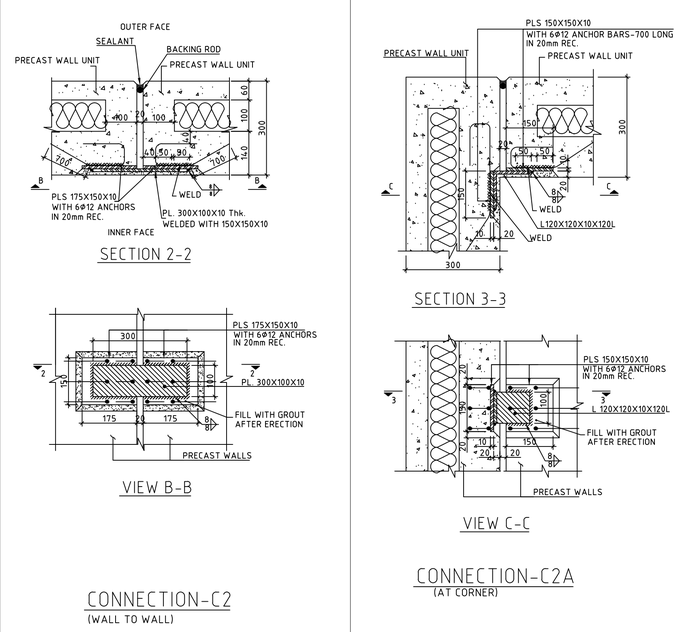
RA140-32-BUI-CW-DW-65664-4

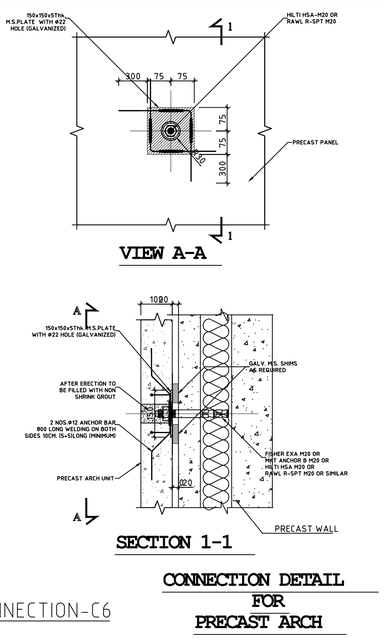
REV.

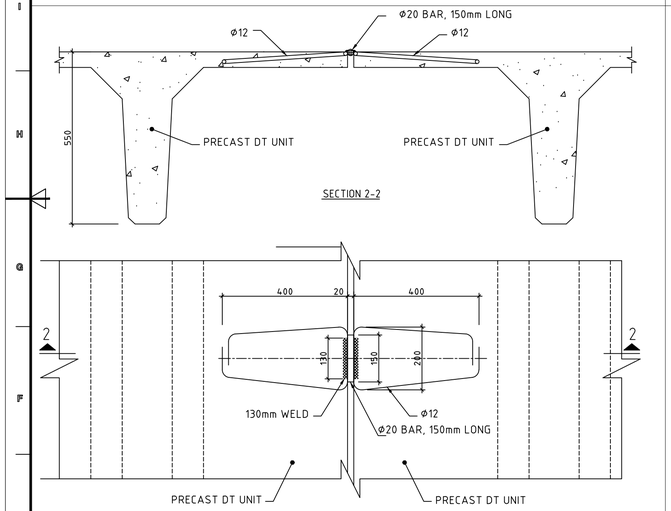
C1

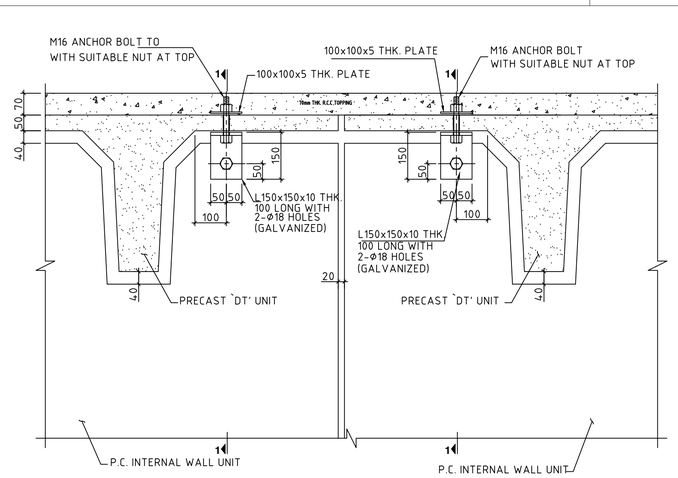


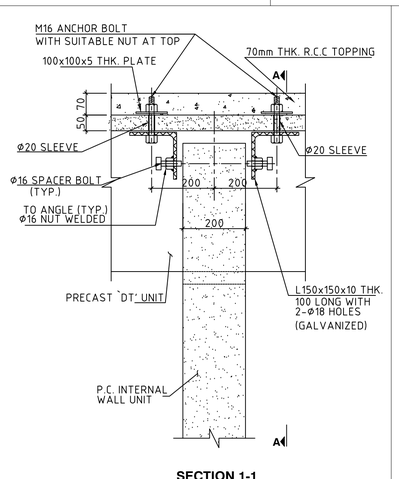


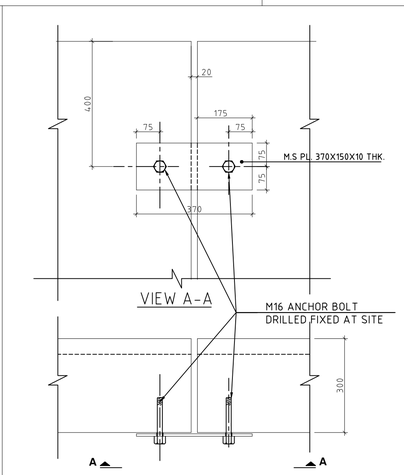


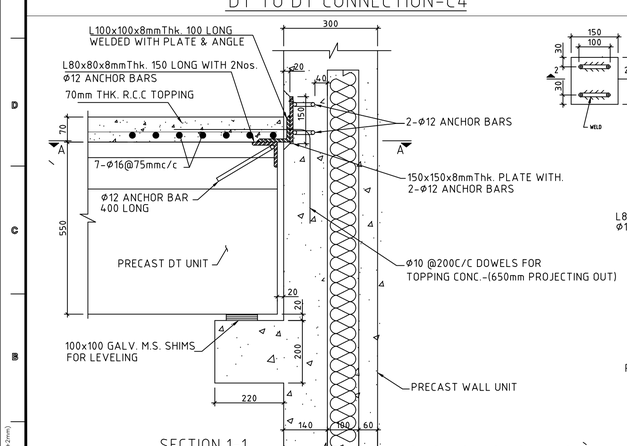


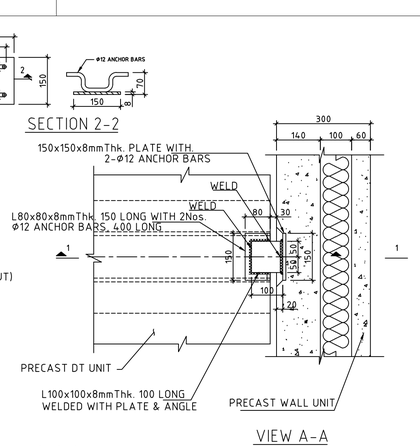


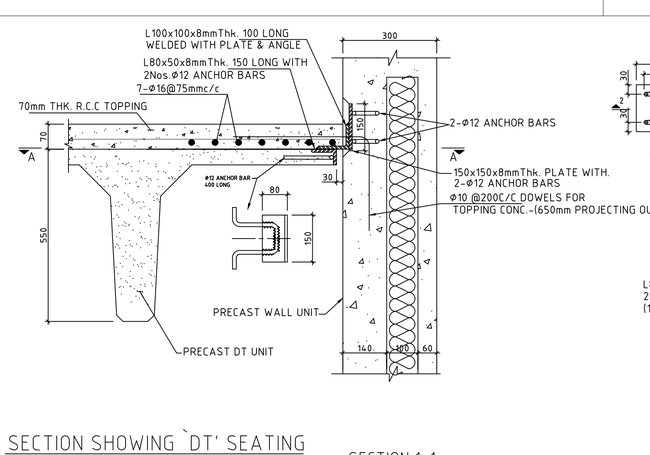


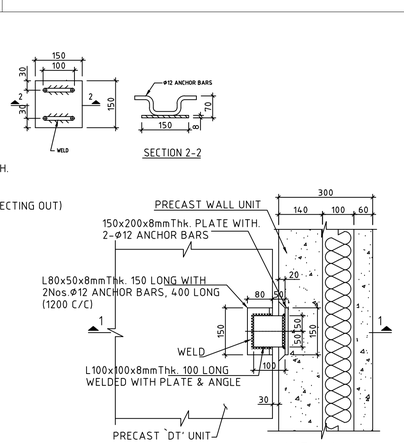












REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH
CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS -STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
ERECTION PLAN FOOTING AND TRENCHES

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:10	EJL	JSK	HSH	BCP
DATE ISSUED				
02.07.17	02.07.17	02.07.17	02.07.17	02.07.17

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

RA140-32-BUI-CW-DW-65665

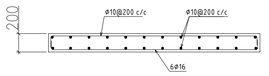
REV.

C1

A0(841X1189mm +2mm)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE INMETERA UNLESS OTHERWISE SPECIFIED.



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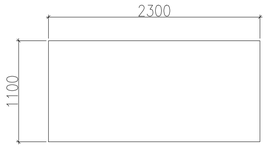
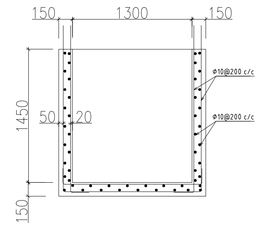


TRANSFORMER SUPPORT SLAB UNIT



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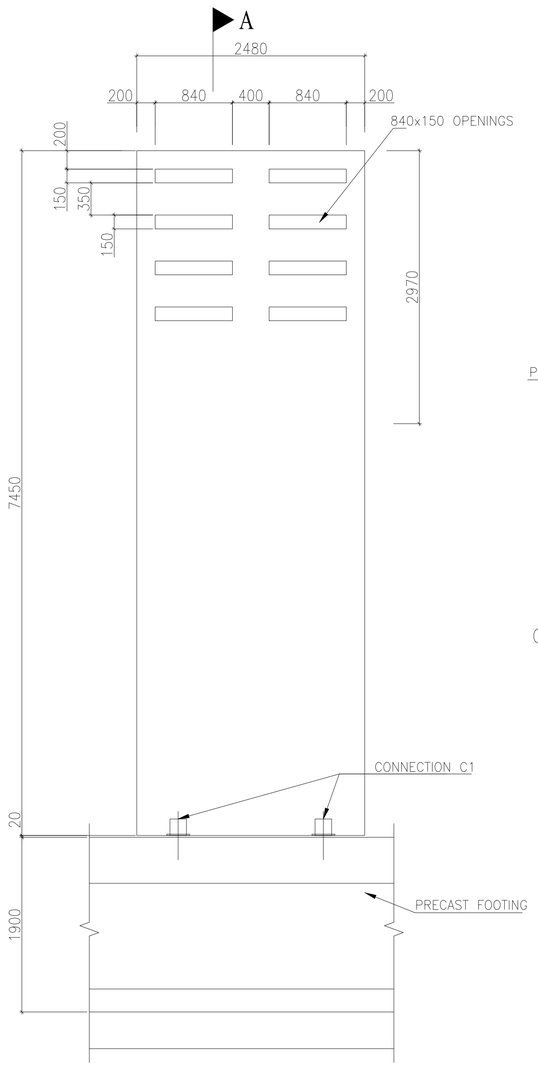

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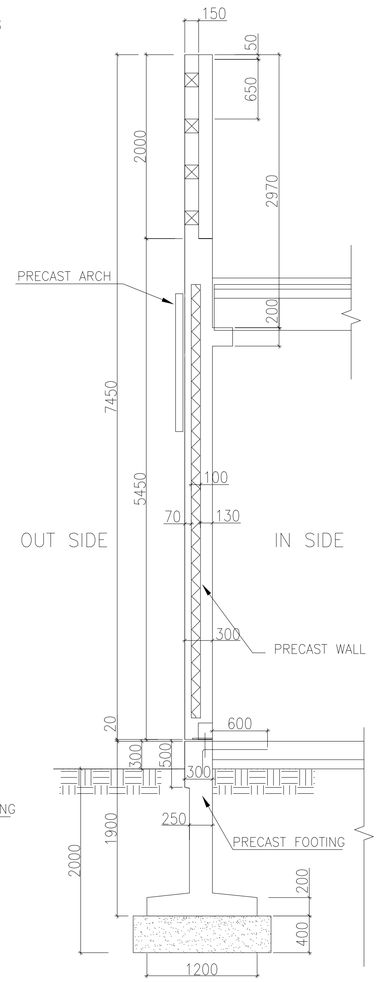

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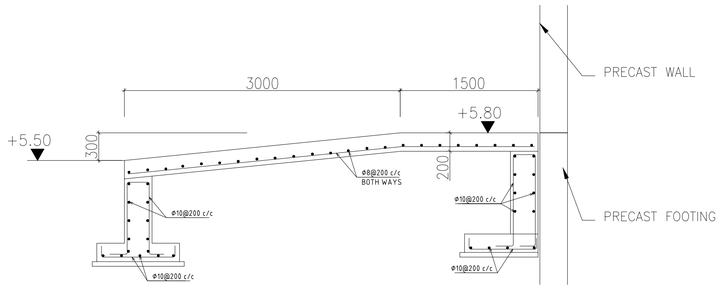

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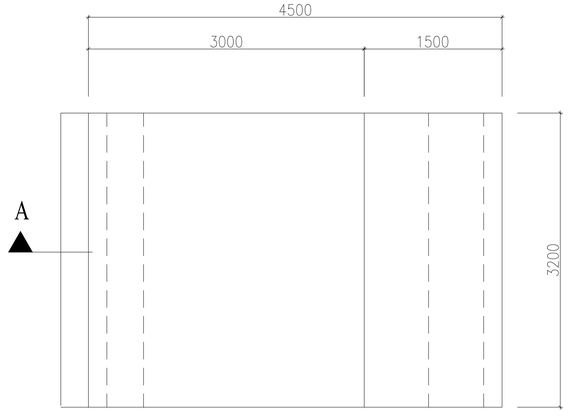


PLAN

RAMP DETAIL

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHEC.	APPRO.
C1	02.07.17	FOR APPROVAL	EJL	HSH	BCP

EMPLOYER

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

PROJECT TITLE

SHEIKH JABER AL AHMAD AL SABAH CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140

DRAWING TITLE

ADMIN&FACILITY BUILDINGS-STRUCTURE
SOUTH ISLAND SUBSTATION BSS 2
TYPICAL WALL DETAILS

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:50	EJL	JSK	HSH	BCP
DATE ISSUED	02.07.17	02.07.17	02.07.17	02.07.17
02.07.17				

CONTRACTOR

HYUNDAI ENGINEERING & CONSTRUCTION
Combined Group Contracting Company

PRECAST SUPPLIER

REAL ESTATE CONSTRUCTION & FABRICATION CO.
RECAFCO
P.O.BOX 24478, SAFAT ,13105, KUWAIT. TEL.23260054, FAX .23260067.

DRAWING NO.

RA140-32-BUI-CW-DW-65666

REV.

C1

TYPICAL PRECAST WALL DETAILS

A0(841X1197mm +/-2mm)

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS
ROADS ADMINISTRATION

وزارة الأشغال العامة
MINISTRY OF PUBLIC WORKS

Design Calculations

Precast Concrete Structure
for
11kV Substations BSS-1 & BSS-2

Ref No.: RA140-DAH-HD-17- 2334

Sheikh Jaber Al-Ahmad Al-Sabah Causeway Project
Main Link – Contract RA/140

HYUNDAI ENGINEERING & CONSTRUCTION

Combined Group Contracting Company

STATE OF KUWAIT
MINISTRY OF PUBLIC WORKS

SHAIKH JABER CAUSEWAY PROJECT
ELECTRICAL SERVICES BUILDINGS

BSS1 & BSS2

DESIGN OF PRECAST CONCRETE STRUCTURE

DESIGN CALCULATIONS FOR PRECAST CONCRETE STRUCTURE & FOUNDATION

Contractor:
HYUNDAI – COMBINED GROUP Co.

Sub-Contractor:
ENERGY SOLUTIONS CO.
KUWAIT.

FOR APPROVAL

NOTE No. : RE – DC – 1
TOTAL 31 + 1 SHEETS.
(Excluding pages of Codes & catalogues.)

Rev.	Date.	Description.
R0	June, 18, 2017	First Preparation.

PRECAST CONCRETE SUB-CONTRACTOR:
Real Estate Construction & Fabrication CO., (RECAFCO)
P. O. Box 24478, SAFAT,
13105, KUWAIT.
Tel.: 23260054. Fax.: 23260067. e-mail: fm@ recafco.com

CONTENTS

Sketches attached:

Copy of relevant pages from EN 1992-1-1:2004+A1:20104,
PCI Design Handbook Seventh Edition,
IBC 2009, 'Roark's'Formulas for Stress and Strain,
Stress Area details for Bolts
(20+23+4+3+5+1 = 54 pages) are also enclosed.

General:-

The objective of this design note is to illustrate the design of the precast concrete units in the project and the connection to the base. The BSS buildings are of size 10.9m x 32.2m, CMPSS buildings are of size 10.9m x 27.9m & the TSS building is of size 10.9m x 25m. Since the maximum size of the building is 10.9m x 32.2m, building of size 10.9m x 35m is designed here.

As the EUROCODE does not deal with all possible cases, For example, the clauses 6.2.2, 6.2.3(8)of EN 1992-1-1:2004+A1:2014 deal with discontinuous corbel and there is no mention to deal with continuous corbel as in our case. Hence, in general, the precast concrete units are designed following the principles given in the "PCI Design Handbook" **with limiting values for stresses and all Load factors as in EUROCODE**.

Example 4.5.11.1 of PCI Design Handbook 7th edition may be referred to as it deals with a building similar to our case of precast concrete walls & DT Roof slabs.

Copy of all relevant pages of the referred documents are attached herewith for Ready reference.

Data:-

Density of concrete = 25 kN/M^3.
Live Load on Roof = 5kN/m^2.(Max.).
Roofing Layers Loads:

110mm avg. thick Light-weight concrete	= 1 kN/m^2. (for slope)
20mm thick Mortar + 1.52mm EPDM	= 0.5 kN/m^2.
100mm thick Insulation + P.E Vapour Barrier	= 0.05 kN/m^2.
Other finishes & Cable Trays	= 1.45 kN/m^2.
	Total= 3.00 kN/m^2.

From the Soil Investigation Report,
Lowest Safe Bearing Capacity of soil at 1.5m below G.L = 1.3 kg/cm^2.
= 130 kN/m^2.

For RCC elements,
Cylinder strength of concrete at 28 days = 30 MPa.
Cylinder strength of concrete at time of stripping = 16 MPa.
For Prestressed concrete elements,
Cylinder strength of concrete at 28 days = 40 MPa.
Cylinder strength of concrete at time of stripping = 28 MPa.

For Seismic effect, **V = 0.08 W.**

For a Basic Wind speed of 35 m/s, v_m = 1.0x1.0x35 = 35 m/s.
We shall consider a wind force of 1.8 kN/m^2.

From Table 3.1 and Clause 3.1.8 of EN 1992-1-1:2004,

For a cube strength of 20 MPa; f_{ctm} = 1.6 MPa.

For a cube strength of 35 MPa; f_{ctm} = 2.6 MPa.

As per **EN 1992-1-1:2004** clause **9.6.2** for Precast Concrete wall, Minimum reinforcement to be provided = **0.001** x Cross-section area, near Each face of the wall.

As per **EN 192-1-1:2004** clause **9.6.2 (3),** Maximum allowable spacing of reinforcement is **3xThickness of panel** or 400mm whichever is less.

As per table 5.3.3.1 of PCI Design Handbook, impact factor considered
At time of stripping = 1.3
At time of handling = 1.2
At time of transport = 1.5

As per **EN 1992-1-1:2004** clause **2.3.1.2(2)** for the Precast Concrete structure not subject to Fatigue case, Thermal Effects need not be considered.

As per **Table 721.3.2 of IBC-2009,** For a **Fire-Resistance rating** of 2 Hours in the case of Concrete using Limestone aggregates, minimum thickness required = 4.0 in. = 100 mm.

As per **Table 721.2.3(1)of IBC-2009,** Cover thickness required is 0.75 in. = 20 mm.

However, a cover of 30mm is provided for the steel reinforcement in all exposed faces. Thus satisfying the requirements of Fire resistance of 2hrs.

Design of Roof DT Slab units:- (See sketch on Sheet 16)

The DT slab elements are produced in the Factory production hall as **prestressed** concrete units and transported & erected in place at site after attaining the required strength. Check for stress conditions at all the stages is carried out in this design note in the following:. **DT+Topping concrete will act as Composite section upon hardening of topping concrete.**

Longitudinal Bending:-

```
WIDTH OF ELEMENT .................=  248  cms.
PRECAST DEPTH OF ELEMENT .........=  50  cms.
THICKNESS OF PRECAST FLANGE ......=  5  cms.
GRADE OF PRECAST CONCRETE ........=  50  MPa.
GRADE OF STRUCTURAL SCREED .......=  30  MPa.
THICKNESS OF STRUCTURAL SCREED ...=  7  cms.

LENGTH OF ELEMENT ................=  10.3  m.
SPAN OF ELEMENT ..................=  10.1  m.

DETAILS OF LOADS INPUT ::
SELF-WEIGHT OF PRECAST ELEMENT @ 2500 KGs/Cu.m. =  689.375  Kgs/m.
DEAD LOAD OF STRUCTURAL SCREED @ 2500 KGs/Cu.m. =  437.5  Kgs/m.
SUPER IMPOSED DEAD LOADS  =  300  Kgs/Sq.m.
LIVE LOAD ..............  =  500  Kgs/Sq.m.

SECTION CONSIDERED IS AT  5.05 m. FROM LEFT SUPPORT (Mid-Span)
AT THIS SECTION ::

No. OF STRANDS EFFECTIVE ......... ::  4
DISTANCE TO C.G.S FROM BOTTOM FIBRE =  7.5  cms.

SECTION PROPERTIES FOR PRECAST PORTION :
CROSS SECTION =  2757.5  Sq.cms.   Yt =  14.38  cms.   Yb =  35.61  cms.
I =  598264  cms.^4   Zt =  41585  cms.^3    Zb =  16798.8  cms.^3

SECTION PROPERTIES FOR COMPOSITE SECTION ::
AREA = 4113 Sq.cms. Yct = 15.49 cms. Ypt = 8.49 cms. Ypb = 41.5 cms.
Ic= 894548 cms.^4 Zct= 57743 cms.^3 Zpt= 105344 cms.^3 Zpb= 21551 cms.^3

MOMENT DUE TO SELF-WEIGHT      =  879039.3  Kg - cm.
MOMENT DUE TO D.L. OF TOPPING  =  557867.2  Kg - cm.
MOMENT DUE TO SIDL OF FINISHES =  956343.8  Kg - cm.
MOMENT DUE TO LIVE LOADS       =  1593906.3  Kg - cm.

PRESTRESSING FORCE =  4  *  13400  *  2  =  107200  Kgs.
ECCENTRICITY OF THIS FORCE =  28.11348  cms.

STRESS DUE TO VARIOUS FORCES ( Kgs/ Sq. cm. )

DUE TO SELF-WEIGHT  ::
TOP FIBRE =  21.14           BOTTOM FIBER = -52.33

DUE TO D.L OF STRUCTURAL SCREED :
TOP FIBRE =  13.42          BOTTOM FIBRE = -33.21

DUE TO S.I.D.L OF FINISHES ::
SCREED TOP =  16.56         SCREED BOTTOM =  9.08
TOP FIBRE =  9.08           BOTTOM FIBRE = -44.37

DUE TO LIVE LOADS  ::
SCREED TOP =  27.6         SCREED BOTTOM =  15.13
TOP FIBRE =  15.13          BOTTOM FIBRE = -73.95

DUE TO PRESTRESS AT TRANSFER ::
TOP FIBRE = -33.6           BOTTOM FIBRE =  218.28

% OF LOSS OF PRESTRESS =  18.22  %

DUE TO FINAL PRESTRESS AFTER ALL LOSSES ::
TOP FIBRE = -27.48          BOTTOM FIBRE =  178.49
```

TOTAL CONCRETE STRESSES AT VARIOUS STAGES : (Kgs/Sq. cm.)

AT TRANSFER OF PRESTRESS :
TOP FIBRE = -12.46 BOTTOM FIBRE = 165.95
ON LAYING TOPPING :
TOP FIBRE = 0.96 BOTTOM FIBRE = 132.74
ON LAYING FINISHES :
SCREED TOP = 16.56 SCREED BOTTOM = 9.08
TOP FIBRE = 10.04 BOTTOM FIBRE = 88.37

FINAL STRESS AFTER ALL LOSSES & INCLUDING LIVE LOADS :
SCREED TOP = 44.16 SCREED BOTTOM = 24.21
TOP FIBRE = 16.16 BOTTOM FIBRE = -25.37

REQUIRED TRANSFER STRENGTH OF CONCRETE IS 35 MPa. on cubes.

ALLOWABLE STRESSES, AS PER EN 1992-1-1:2004, AT VARIOUS STAGES ARE AS FOLLOWS:
TENSION IN PRECAST CONCRETE, AT TRANSFER = 26 Kgs/cm^2.(Table 3.1)
TENSION IN PRECAST CONCRETE, AFTER ALL LOSSES = 35 Kgs/cm^2.(Table 3.1)
COMPRESSION IN PRECAST CONCRETE, AT TRANSFER = 200 Kgs/cm^2. (Clause 5.10.2.2 (5))
COMPRESSION IN PRECAST CONCRETE, AFTER ALL LOSSES = 225 Kgs/cm^2.(Clause 5.10.2.2 (5))

COMPRESSION IN STRUCTURAL TOPPING CONCRETE = 100 Kgs/cm^2.

CHECK FOR SHEAR.

CONSIDERED SECTION IS AT .35 m. FROM SUPPORT.
AT THIS SECTION:

ULTIMATE SHEAR FORCE V = 21027.3 Kgs.
ULTIMATE MOMENT AT THIS SECTION M = 778202 Kg-cm.
MOMENT REQUIRED TO MAKE 0 STRESS AT BOTTOM FIBRE Mo = 2363105 Kg-cm.

SECTION UNCRACKED IN SHEAR. HENCE Vc = Vco.
Vcr = 68403.5 Kgs. Vco = 18192.44 Kgs.
THEREFORE, Vc = 18192.44 Kgs.

SINCE Vc/2 < V < (Vc+0.4 x Bv D), PROVIDE MINIMUM LINKS AS BELOW.
PROVIDE 5 mm. Dia LINKS AT 200 mm. c/c

The prestressed DT element will have a camber and not a deflection.

Check for Ultimate Moment Capacity:- (Composite section)

Considering only prestressing strands, A_{sp} = 2x4x100 = 800 mm^2.

Ultimate tension T = 0.87 x (800 x 1860) = 1294560 N.
Depth of Compression zone in Concrete = 1294560/(0.80x28x2500)
= 23.12 mm.
Lever arm = (570-100-11.56) = 458.44 mm.

M_r = 129450 x 458.44 / 10^6 = 593.47 kN-m.

Mu = [1.35 x (7.0+5+9.0)+1.5 x 2.5] x 11.36^2/8 = 517.81 kN-m. << M_r Hence safe.

Check for transfer of Horizontal shear at interface:- (Refer Clause 6.2.5 of EN 1992-1-1:2004)

As per EN 1992-1-1:2004+A1:2014, Clause 6.2.5,
At the interface, b_i = 2480 mm. (Width of cross section at contact surface being investigated)

z = (500+70-100-12.13) = 457.87 mm.

V_{Ed} = [1.35 x (7.0+5+9.0)+1.5 x 2.5] x 11.36/2 = 182.328 kN.

v_{Edi} = 1.0 x 182328/(457.87x2480) = 0.160 MPa.
From Eq. (6.25) v_{Rdi} = 0.4x(1.8/1.5)+0.7x0.051+0 = 0.516 MPa. >> v_{Edi}

Hence, the composite section is safe without any reinforcement steel links between DT and Structural Topping concrete.

Transverse Bending of Flange slab of DT:-

Cantilevering part of DT

During casting of Structural Topping concrete:

Length of Cantilever from Tip of 100mm x 100mm Haunch = 460 mm

Thickness of flange slab = 50mm. d = 30+8+4 = 42mm (Top cover is temporary)

Topping Concrete thickness = 70mm.

Construction load = 2 kN/m^2. (Temporary)

Ultimate Load = 1.35x(1.25+2.0)+1.5x2 = 7.4 kN/m^2.

Mu = 7.4 x 0.46^2/2 = 0.78 kN-m/m.

For a reinforcement of ϕ8mm@150mm c/c = 335 mm^2/m = 0.8%

From Figure 3.5 of EN 1992-1-1:2004+A1:2014 (E); for λ=0.8 & η= 1.0;

$F_s = F_c$ = 335 x (414/1.15) = 120600 N/m.

f_{cd} = 1.0x40/1.5 = 26.67 MPa.; λx = 120600 / (1000 x 1.0 x 26.67) = 4.52 mm

Lever arm = 42 – (4.52/2) = 39.74 mm.

∴ M_r = 120600x39.74/10^6 = 4.79 kN-m/m >> 0.78 kN-m/m Hence Safe.

V_u = 7.4x0.46 = 3.404 kN/m.; From Eq. (6.2.a) of EN 1992-1-1:2004,

$V_{Rd,c}$ = [(0.18/1.5)x2x(100x0.008x40)$^{1/3}$+0.15x0]x1000x42 / 1000 = 32.00 kN/m. >> V_u.

Hence, Safe.

After Hardening of Topping & laying finishes:

d = 120-30-4 = 86mm.

Ultimate Load = 1.35x(3.25+3.1)+1.5x1 = 10.07 kN/m^2.

Mu =1.07 kN-m/m.

For a reinforcement of ϕ8mm@150mm c/c = 335 mm^2/m = 0.35%

From Figure 3.5 of EN 1992-1-1:2004+A1:2014 (E); for λ=0.8 & η= 1.0;

$F_s = F_c$ = 335 x (414/1.15) = 120600 N/m.

f_{cd} = 1.0x28/1.5 = 18.67 MPa.; λx = 120600 / (1000 x 1.0 x 18.67) = 6.45 mm

Lever arm = 86 – (6.45/2) = 82.78 mm.

∴ M_r = 120600x82.78/10^6 = 9.98 kN-m/m >> 1.07 kN-m/m Hence Safe.

V_u = 10.07x0.46 = 4.63 kN/m.; From Eq. (6.2.a) of EN 1992-1-1:2004,

$V_{Rd,c}$ = [(0.18/1.5)x2x(100x0.008x28)$^{1/3}$+0.15x0]x1000x86 / 1000 = 58.18 kN/m. >> V_u.

Hence, Safe.

Part of DT flange between Ribs (Consider as Simply supported on the Haunches of Ribs)

During casting of Structural Topping concrete: (Check as plain concrete slab section)

Span of slab = 840 + 50 + 50 = 940 mm

Thickness of flange slab = 50mm. d = 50-20-8-4 = 18mm (Top cover is temporary)

Topping Concrete thickness = 70mm.

Construction load = 2 kN/m^2. (Temporary)

Service Load = (1.25+2)+2 = 5.25 kN/m^2.

M = 5.25 x 0.94^2/8 = 0.58 kN-m/m.

Extreme fiber stress = M/z = 0.58x10^6/(1000x50^2/6) = 1.39 MPa. << 3.5 MPa.

Hence safe as Plain Concrete.

V_u = 7.4x0.47 = 3.478 kN/m.; << 32.00 kN/m.

Hence, Safe.

After Hardening of Topping & laying finishes:

d = 120-32 = 88mm.

Ultimate Load = 1.35x(3.25+3.1)+1.5x1 = 9.92 kN/m^2.

Mu =1.10 kN-m/m. << 11.19 kN-m/m Hence, Safe.

V_u = 15.2x0.47 = 7.144 kN/m.; << 58.18 kN/m.

Hence, Safe.

Provide Y8 @ 150mm c/c (= 335 mm^2 / m width.) both-ways in precast concrete flange and y8 @ 200mm c/c both-ways in Topping Concrete.

Check for Diaphragm Shear due to lateral forces: (See Sketch on Sheet 17)

Base shear coefficient Cs = 0.08 (For Seismic load)

For a given length of 2.5m along the length of Substation,

Weight of DT unit	= 10.3 m x 7.0 kN/m	= 72 kN.
Weight of Topping + Finishes	= 10.3 m x (5+7.5)kN/m	= 132 kN.
Live Load	= 10.3 m x 12.5 kN/m	= 130 kN.
Wall Weight	= 2x7.45 m x2.5 m x0.2 m x25	=186 kN.

Total Gravity loads = 72+132+130+186 = 520 kN./2.5m = 208 kN/m length.
Total Base Shear = 0.08 x 208 = 16.64 kN/m.
Total Wind force = 7.45 m x 1.8 kN/m^2.= 13.41 kN/m.
Maximum Horizontal force = 16.64 kN/m.

Wind Load Shall not be combined with Seismic Loads.
Distance between Shear walls in a 35 m module = 35 m.
See Figure 4.8.1 of PCI Design Handbook/seventh edition.

Considering 60% - 40% distribution. & 10% accidental over loading

$V_L = V_R$ = 16.64 x 35 x 0.66 = 385 kN.(Max); M = 16.64 x 35^2/8 = 2548 kN-m.
Maximum Shear between Components = 2 x 2.5 x 385 / 35 = 55.00 kN.
Chord Force C = T = 2548 / 9.5 = 268 kN. (For a lever arm of 9.5m)
Area of Steel provided in the Topping Concrete to take up this force = 268000 / (0.6x420) = 1064 mm^2.
Provide 7ϕ16mm bars along the periphery of the slab in Topping concrete.

Connection between DT & Wall : (Connection C3, C3A – See Sheet 22, 23)
Number of Connections in 35 m = (35/2.5)x2 = 28 Nos. on each 35m side.
Force per Connection = 385 / 28 = 13.75 kN.
Length of 6mm filet weld required = 13750 / (0.7x6x115) = 28.5 mm.
Provide 100mm long Angle 80x80x8mm thick welded to plates on wall & DT rib, providing an effective weld length of 200mm. (Capacity = 13.29x200/27.5 = 97 kN)
Capacity of ϕ10mm @200mm c/c dowel bars in shear = 5x78.5x100/1000 = 39 kN/m
Capacity of ϕ12mm @200mm c/c dowel bars in shear = 5x113x100/1000 = 56 kN/m

Total Capacity required = 385 kN.
For the 11.5m long side, provide 8 Nos. Angle welded connections on each side.
Total Provided capacity = 8x97 + 11.5x39 = 1224 kN. OK, Safe.

Connection Between DTs :- (Connection C4 – See Sheet 30)
The maximum shear is at first joint away from 12 m side wall.
Shear = (17.5-2.5)x372/17.5 = 319 kN.
Provide 8 Nos. 130mm Welded connections.
Shear strength of 8 each 2 Nos. 12mm dia bars = 8x2x113.05x0.5x420 = 379 kN. Safe. And this is in addition to the shear resistance between DT & Topping concrete.

Design of wall units:-

External Wall Units:-

(See Sketch in Sheet 18)

Design of Corbel in Wall units:-

The Wall units are provided with continuous corbels but are supporting the DT slab with levelling shims at each of the two ribs per DT panel. Check for stress conditions at the support points is carried out in this design note in the following:

Bearing Stress:-

Maximum weight from one DT unit = 72+132+130 = 334 kN
Load at one support = 334 / 4 = **84** kN (max.)
Using shims of size 150mm x 100mm plan dimensions, bearing stress on concrete = 1.4 x 84000 / (15000) = 7.84 MPa. < 14 MPa. (0.4 x 35)
Hence OK.

The corbel is designed as a Ledge:- **(Refer Example 5.5.1 of PCI MNL 120). For Limiting values of stresses, Clause 6.2.2 of EN 1992-1-1:2004+A1:2014 is referred to:**

For corbel tensile reinforcement of **ϕ8mm @ 125mm c/ c (=402mm²/m)**, from Eq. (6.2.a), (6.3N) of EN 1992-1-1:2004+A1:2014
Shear stress $v_{Rd,c}$ = (0.18/1.5)x2x(100x0.0023x30)$^{1/3}$+0.15x0 = 0.46 MPa.
from Eq. (6.2.b), (6.3N) of EN 1992-1-1:2004+A1:2014
Shear stress $v_{Rd,c}$ = (0.035)x(2)$^{3/2}$x30$^{1/2}$+0.15x0 = **0.54 MPa.**

From PCI-MNL 120 Example,
Width of Bearing area = b_t=150mm; h_ℓ = 200mm; b = 140mm; b_ℓ = 370mm;
Minimum spacing between shims s = 1200mm (>b_t+ h_ℓ)
Hence, As per Eq. 5-44, $V_{Rd,c}$ = **0.54**x200x[2x220+150+200]
= **85,320 N**
As per Eq. 5-45, $V_{Rd,c}$ = **0.54**x200x[2x220+150+200+2x600]
= 209,520 N
This is more than **84**kN. **Hence, OK.**
Shear Span a = 0.75x(350-140)+25 = 182.5 mm.

By Eq. 5-49: A_s = [100000x(182.5/175)+10000x(200/175)]/(0.75x420)
= 368 mm².
6 h_ℓ = 1200mm > s/2 (500mm). Hence distribute this reinforcement over s/2 on each side of the support with spacing not more than 200mm.
Provide ϕ8mm @ 125mm c/ c (=402mm²)
By Eq. 5-50: A_ℓ = 1.38x220x175/(0.75x420) = 169 mm².
Provide 1+1 ϕ16mm bar(=201mm²)
As the wall is seated on the base structure, there will not be beam torsional effect in this case. Hence, A_{sh}, A_{wl}, A_{wv} are not needed.

Provide ϕ8mm @ 125mm c/ c (=402mm² / m) Vertical bars for the walls in the inner face.

Design of Wall units:-

These sandwich wall elements are produced in the Factory production hall and transported & erected in place at site after attaining the required strength. Check for stress conditions at all the stages is carried out in this design note in the following:

The largest wall panel in this project is of size (7.45m x 2.48m x 0.30m thick including 100mm insulation material between 70mm thick outer wythe and 130mm thick inner wythe)

At Stripping Stage:-

(Refer fig. 8.3.2 Eight Point Pick-up case of PCI Design Handbook – copy attached for ready reference.)

IMPACT FACTOR

$w = 1.3 \times 0.30 \times 25 = 9.75$ kN/m^2.

a = 2.48m; b = 7.45m; b/4 = 1.86m; 15t = 15 x 0.15 = 2.25m.

$\pm M_x = 0.0054 \times 9.75 \times 2.48^2 \times 7.45 / 1.86 = 1.29$ kN-m/m.

$\pm M_y = 0.0027 \times 9.75 \times 2.48 \times 7.45^2 / 1.24 = 2.92$kN-m/m.

For the Composite section, with the connecting ribs @ 790mm c/c, the neutral axis is at 135mm from inner face.
Section Modulus for the Inner face = Z_i = 15,049 cm^3/m. and
Section Modulus for the Outer face = Z_o = 12,313 cm^3/m.
Hence, maximum extreme fibre stress = M_{max} / Z
= 2.92×10^6 /12313000
= 0.24 MPa. << 1.6 MPa.

Hence, plain concrete section will be safe. However, As per **EN 1992-1-1:2004+A1:2014** clause **9.6.2** provide minimum reinforcement of 0.001 x cross section area, on each face.

Area of steel required = 0.001 x 200 x 1000 = 200 mm^2 / m width.

Provide Y8 @ 150mm c/c (= 335 mm^2 / m width.) Vertical & Y8@250mm c/c Horizontal for the Inner Face and Similar reinforcement for the Outer Face.

At Transportation & Erection Stage:-

The unit will be transported flat on trailer, providing support at same points as for stripping. Hence it is safe.

At Tilting:- (See sketch in Sheet 17)

The wall unit is mounted on a steel frame with clamps and tilted to vertical with the support of the frame, at site with the hooks provided at top of the panel for the purpose.
This eliminates the temporary flexural stresses in the wall panel.
The steel frame will consist of 3 main I beams IPE 270@36.1 kg/m, inter connected with cross channels UPN 200@25.3 kg/m.

Total Bending moment = $1.2x(2.5x7.5)x7.45^2/8 = 156$ kN-m.
For IPE 270@36.1 kg/m section, Z = 429 cm^3.
Bending stress in steel = 1560000/(3x429)= 1215 kg/cm^2.<< 1650kg/cm^2.
Hence Safe.

The steel frame will be removed by releasing the clamps and the wall panel will be lifted & placed in position on the anchor bolts. The verticality, position & alignment adjustments will be done using a set of two push-pull props and connection will be established.

At Service Stage:-

Self-weight of wall = 7.45x0.25x25 = 46.6 kN/m.
Roof slab, DT, screed, water proofing etc. = **39.3** kN/m.
Roof Live Load = 5.0 kN/m^{2}x 5.2m = 26.0 kN/m.
Eccentricity of the Roof load on wall = 12.5+13 = 25.5cm. Causing tension in the outer face of the wall.
Moment due to eccentric roof loads = (39.3+26)x0.255 = 16.65 kN-m/m.

Moment due to Wind load = 1.8x5.0^2/8 = 5.63 kN-m/m causing compression in the outer face of the wall.
However, it is considered to be adding with the eccentric roof load moment – on a conservative side.

For the composite section, stresses in concrete due to working loads are:
P/A = (46600+39300+26000)/(1000x200) = 0.56 MPa.
M_a = 16.65+5.63 = 22.28 kN-m/m.
Stress At the Inner face = 0.56 + (22.28x10^6/15049000) = 2.04 MPa.
Stress At Outer face = 0.56 – (22.28x10^6/12313000) = -1.25 MPa.
AS can be seen, these stresses are well within the limits of the concrete capacity.

Design for Ultimate loads: Refer Clause 5.8.3 of EN 1992-1-1:2004+A1:2014.
For 1 m width of the Composite wall panel,
b = 1000mm; h = 140+100+60 = 300mm. f_{ck} = 30 MPa.
Properties of the Composite section:
I = (100x13^3/12)+1300x(13.5-6.5)^2+(100x7^3/12)+700x13^2 = 203167 cm^4.
Z_i = 15049 cm^3. And Z_o = 12313 cm^3.; radius of gyration r=10.08 cm.
Es = 20000 MPa.; Ec = 33000 MPa.; ℓ_o = 5050 mm.
ℓ_o/150 = 33.7 mm.
The wall is simply supported, The cross-section is constant over the height of the wall.
Relative normal force n =(1.35(46.6+39.3)+1.5x26)/(200000x(30/1.5))
=0.0387
From Eq. (5.13N) of EN 1992-1-1:2004+A1:2014,
λ_{lim} = **20x0.7x1.1x0.7/(0.0387)$^{1/2}$ = 54.80.**
From Eq. (5.14) of EN 1992-1-1:2004+A1:2014,
λ = **5050/100.8 = 50.10. < λ_{lim}** Hence, as per clause 5.8.3.1(1), Second order effects need not be considered.
Axial Force N_{Ed} = 1.35x(46.6+39.3)+1.5x26 = 154.965 kN/m.
Max. Moment M_{Ed} = 1.5x22.28 = 33.42 kN-m/m.
From Clause 5.8.9(4) of EN 1992-1-1:2004+A1:2014,
N_{Rd} = [(200000-3x402)x(28/1.5)+3x402x(420/1.15)]/1000
= 4151 kN/m.
Hence, a=1.0
Ref. Clause 3.1.7 of EN 1992-1-1:2004+A1:2014,
M_{Rd} = 402x(420/1.15)x(266-3.67)/10^6 =38.52 kN-m/m. > M_{Ed} Hence OK.

Ref. Eq. (5.39) in Clause 5.8.9(4)of EN 1992-1-1:2004+A1:2014,

$(33.42/38.52)^{1.0}$ = 0.868 << 1.0 Hence OK.

Ultimate Horizontal Shear Stress at Ribs= 0.08x2.5x154965/(4x100x250)
= 0.31 MPa. << 0.55 MPa. Hence OK.

Horizontal Shear Stress Due to Shear wall action, considering only 1.8m (60% of 2.75m) width of wall effective
= (385000/4)/(1650x200)=0.30 MPa. OK.

Provide ϕ8mm @ 125mm c/c (=402 mm²/m width.)Vertical reinforcement and ϕ8mm @ 250mm c/c Horizontal steel reinforcement.

Design of Connection to Base:- (Connection C1 – see Sheet 25)

The 2.5m (or 3m) wide wall unit is seated on the Cast-in-situ base structure using 2 sets of minimum 150mm x 150mm M.S shims and connected using Anchor bolts to ASTM F1554 embedded in the base structure.

Refer page 4-35 of PCI Design Handbook/seventh edition.

Total Horizontal force = 385 kN On 4 Wall Panels or 385 kN on 14 Panels
Consider the shorter direction (10.9m)for the Alternate method as defined.
Factored Load as per Eq. (4-34) of PCI is,
$(09-0.2S_{DS})D$ = (0.9-0.2x0.2)x (4x2.75x(46.6+5)) = 488.2 kN
Providing One Connection at 5.05m above base concrete slab, and maintaining the distance between base connections within one panel as 2.0m c/c,

Design base connection for $1.0E-(0.9-0.2S_{DS})D$,
T_u = (385x5.05 – 488.2x6.0) / 10.6 = -92.92 kN.
C_u = (385x5.05 + 488.2x6.0) / 10.6 = 459.8 kN.

This Axial Tension of 92.92 kN will act on two anchors at the corner (=46.5 kN/Anchor). The compression will be transferred to the base concrete by bearing through metal shims. But, the Shear will be taken by all the anchors as below:

Shear on Each Bolt = 0.08x(46.6+39.3+26)x2.5/2
= 11.19 kN.

Bearing stress on Concrete = 459.8x1000/(2x150x150)
= 10.22 MPa. < 14 MPa. Hence OK.

Design Each Anchor Bolt for a Tension capacity of 46.5 kN & Shear Capacity of 11.19 kN.

Provide a single anchor bolt with plate and nuts at the buried end (like studded bolts), for each connection.

Using 6mm Fillette weld,

Length of Weld required = 11190 / (0.7x6x115) = 23.2mm

Provide a minimum of 100 mm weld between the Base Plate and the Washer Plate.

Provide M30 dia Bolt to ASTM F1554 Grade 36

Tensile stress in steel = 46500/(561)
= 82.89 MPa. = 12.00 ksi. < 55 ksi. OK.

Shear stress in steel = 11190/561 = 19.95 MPa.
= 2.89 ksi. << 37 ksi. OK.

For Plate insert in Wall:-

Providing 6 ϕ20 Anchor bars for the plate insert in the wall, Tensile stress in bar = (46500/(6x314)) = 24.75 MPa. << 252 MPa. **OK.**

Shear stress in Weld =(46500/(6x3.142x24.2x0.7x6))
= 24.75MPa. <115MPa. **Hence, Safe.**

Check for Adequacy of Plate Thickness for C1:-

Maximum Tension on Bolt = 46.5 kN.

Maximum c/c distance between Anchor bars = 200 mm

Tension force is transferred from Bolt to Washer, then from Washer to Plate & then from Plate to Anchor Bars.

Consider 100mm x 80mm x 15mm thick Washer with 32mm hole.

Refer Table 11.4 Case 1b of "Roark's Formulas for Stress & Strain by Warren C Young & Richard G Budynas" & Steel Designer's manual - copy of relevant pages attached.

a = 100mm; b = 80mm; $r_o' = r_o$ = 40mm.

Maximum stress in washer Plate is:

σ_{max} = 3x46500x{(1+0.3)x ℓ_n [(2x80/(πx40))+0.685]}/(2xπx15^2)
= 101.5 MPa. < 165 MPa. Hence Ok.

The plate behaves as Fixed supported by the Anchor bars,

Maximum Bending Moment at face of support= 23250 x 50 =1162500 N-mm.

Flexural stress in steel plate = 1162500 / (200x15^2/6)
= 155 MPa. < 165 MPa. **Hence Ok.**

Design of Connection Between Wall panels:- (C2, C2A – Sheets 26, 27)

As seen in the previous page (Sheet No.6, V_L, V_R),
force on each panel = 385/4 = 96.25 kN.

Using 6mm Fillet weld,
length of weld required on each side = (96250 / (0.7x6x115))
= 199.3 mm.
With connection as in Detail C2, length of Weld provided is 330mm.
Using 2x3ϕ12 Dowel bars, with 50mm long welds on each side of the bars with the insert plate, length of weld provided = 400mm.
Tensile stress in bar = 96250 / (6x113.05) = 142 MPa. < $0.6f_y$. **OK.**

However, provide 2 Nos. similar connections extra in the height of the wall.

Check for capacity of Dowels between Wall & Topping in Roof:-
Providing dowels of ϕ10mm @ 200mm c/c, capacity is established in Sheet No. 7 of this design note.

These Dowel Connections are in addition to the 2 Nos. connections between DTs & the wall panel. (Connection C3, C3A – See Sheet 28, 29)

Internal Partition Wall Units:- (Sheet – 20)

These internal partition wall units are 200mm thick solid wall panels. These do not carry any load other than their self-weight.

These elements will also be produced, transported and erected in the same manner as the external walls.

As already seen in the case of the external wall units, these wall units will also be safe with Y8@150 mm c/c vertical bars & Y8@250 mm c/c horizontal bars on both faces of the wall section.

Provide same bolted connection at the base and three plate connections in the height of the wall.

These walls will be laterally held in position by angle brackets drilled fixed to the flange of the DT roof slabs. **(Connection C5 as in Sheet-31)**

Transformer Support Slab:- (Transformer Base- Sheet21)

These Slab units are 200mm thick solid RCC slabs supported on the concrete walls of Trench below.
Weight of Transformer = 3800 kg. = 3.8 kN.
Span of the slab = 1.50 m.
Width of the slab = 1.10 m.
Ultimate moment at mid-span = $(1.35x1.1x0.2x25x1.5^2/8)+(1.5x3.8x1.5/4)$
= 1.33 + 2.14 kN-m. = 3.47 kN-m.

4ϕ16 bars = 804mm^2.
Ref. Clause 3.1.7 of EN 1992-1-1:2004+A1:2014,
M_{Rd} = 804x(420/1.15)x(162-6.68)/10^6 =45.61 kN-m. > M_u Hence OK.

Precast RCC Trenches:- (Sheet – 22)

Concrete trenches are about 1.45m deep (clear inner depth) with wall thickness of 150mm supporting the ground floor RCC slab and retaining the soil outside the trench.

Maximum Load from slab = 2.5m x (0.2x25+3+5) = **32.5 kN/m.**
Weight of trench filled with sand= (2x1.6x.15+1.3x.15)x25+1.3x1x20
= 43 kN/m.
Bearing pressure on soil under trench = (2x32.5+43)/1.6 = 68 kN/m^2.
< SBC Hence, OK.
Maximum Lateral pressure on wall = 0.33x18x1.45 = 8.613 kN/m^2.
Maximum possible moment = 8.613x1.45^2/8 = 2.264 kN-m/m.
For the trench wall section, stresses in concrete due to working loads are:
P/A = (32500)/(1000x150) = 0.21 MPa.
M_a = 2.264 kN-m/m.
Stress At the Inner face = 0.21 + (2.264x10^6/3750000) = 0.82 MPa.
Stress At Outer face = 0.21 – (2.264x10^6/3750000) = -0.40 MPa.
AS can be seen, these stresses are well within the limits of the concrete capacity.

Design for Ultimate loads: **Refer Clause 5.8.3 of EN 1992-1-1:2004+A1:2014.**
For 1 m width of the Trench wall panel,
b = 1000mm; h = 150mm. f_{ck} = 30 MPa.
Properties of the solid RCC section:
I = 100x15^3/12 = 28125 cm^4.
Radius of gyration r=4.33 cm.
Es = 20000 MPa.; Ec = 33000 MPa.; ℓ_o = ℓ/2= 1450/2 = 725 mm.
ℓ_o/150 = 4.83 mm.
The wall is monolithically connected to slabs at top & bottom, The cross-section is constant over the height of the wall.
Relative normal force n =(1.35(2.5x10)+1.5x12.5)x1000/(150000x(30/1.5))
=0.0175
From Eq. (5.13N) of EN 1992-1-1:2004+A1:2014,
λ_{lim} = **20x0.7x1.1x0.7/$(0.0387)^{1/2}$ = 54.80.**
From Eq. (5.14) of EN 1992-1-1:2004+A1:2014,
λ = **725/48.3 = 15.01. <** λ_{lim} Hence, as per clause 5.8.3.1(1), Second order effects need not be considered.
Axial Force N_{Ed} = 1.35x(25)+1.5x12.5 = 52.5 kN/m.
Max. Moment M_{Ed} = 1.5x2.264 = 3.396 kN-m/m.
From Clause 5.8.9(4) of EN 1992-1-1:2004+A1:2014,
N_{Rd} = [(150000-2x393)x(28/1.5)+2x393x(420/1.15)]/1000
= 3072 kN/m.
Hence, a=1.0
Ref. Clause 3.1.7 of EN 1992-1-1:2004+A1:2014,
M_{Rd} = 393x(420/1.15)x(95-3.59)/10^6 =13.12 kN-m/m. > M_{Ed} Hence OK.

Design of Foundation:-

Design of Strip Footing Under External Walls:- (Sheet – 23)

Loads:

From Wall, including Roof loads = 111.9 kN/m (Max.)(see sheet No. 10)
Strip footing weight = 20.1 kN/m.

Total load = 132.0 kN/m.

For width of footing provided = 1.2m.,
Bearing Pressure on Soil = 132/1.2 = 110 kN/m^2. < 130 kN/m^2. Hence, OK.

Design the Footing for a pressure of 150 kN/m^2.
For the Provided 1200mm wide strip footing.
At the root of the foting (face of wall), M_u = 1.5x150x0.49^2/2
= 27.01 kN-m/m.
b = 1000mm; d = 250-50-5 = 195mm; f_{ck} = 30MPa.

For a reinforcement of ϕ10@100mm c/c,
Ref. Clause 3.1.7 of EN 1992-1-1:2004+A1:2014,
M_{Rd} = 786x(420/1.15)x(195-7.12)/10^6 =53.92 kN-m/m. > M_{Ed} Hence OK.

Provide ϕ10mm @ 100mm c/c bars (=786 mm^2)Main reinforcement.

Vertical Shear:-

Upward force from pressure on Soil = 150 kN/m^2.
Downward force due to weight of
Footing and soil above …… = (0.2x25+1.2x18) = 26.6 kN/m^2.

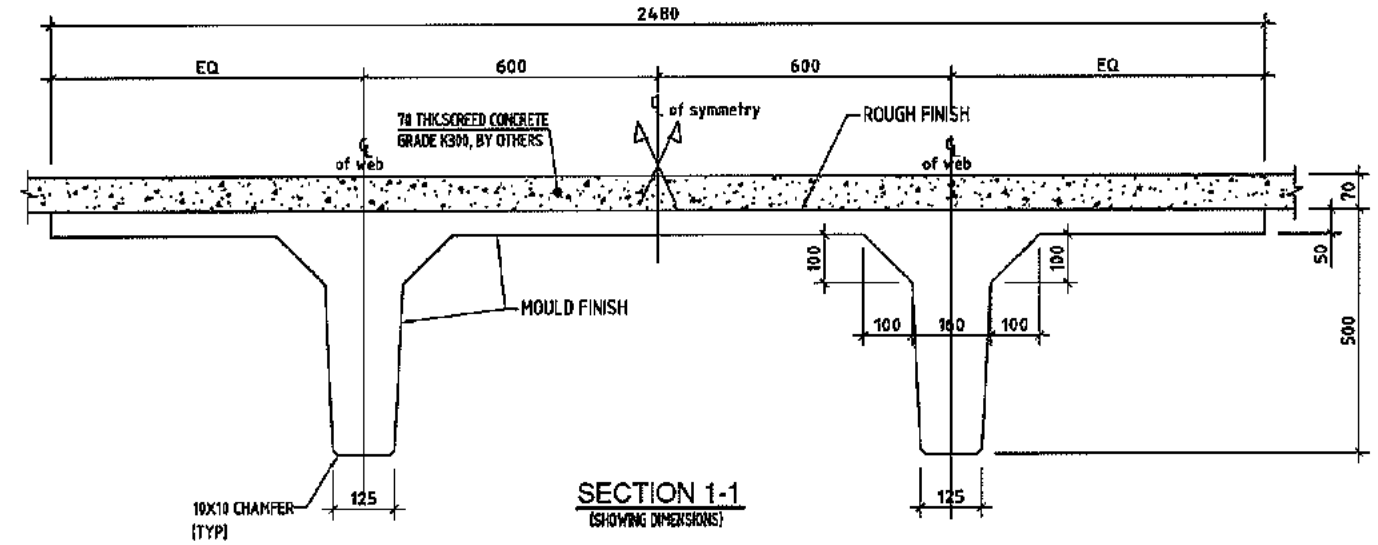
Nett upward force = 150-26.6 = 123.4 kN/m^2. = 125 kN/m^2.
Ultimate shear force = 1.5x125x0.475 = **89.1** kN/m.

From Eq. (6.2.a), (6.3N) of EN 1992-1-1:2004+A1:2014
Shear stress $v_{Rd,c}$ = (0.18/1.5)x2x$(100x0.0023x30)^{1/3}$+0.15x0 = 0.46 MPa.
from Eq. (6.2.b), (6.3N) of EN 1992-1-1:2004+A1:2014
Shear stress $v_{Rd,c}$ = (0.035)x$(2)^{3/2}$x$30^{1/2}$+0.15x0 = **0.54 MPa.**

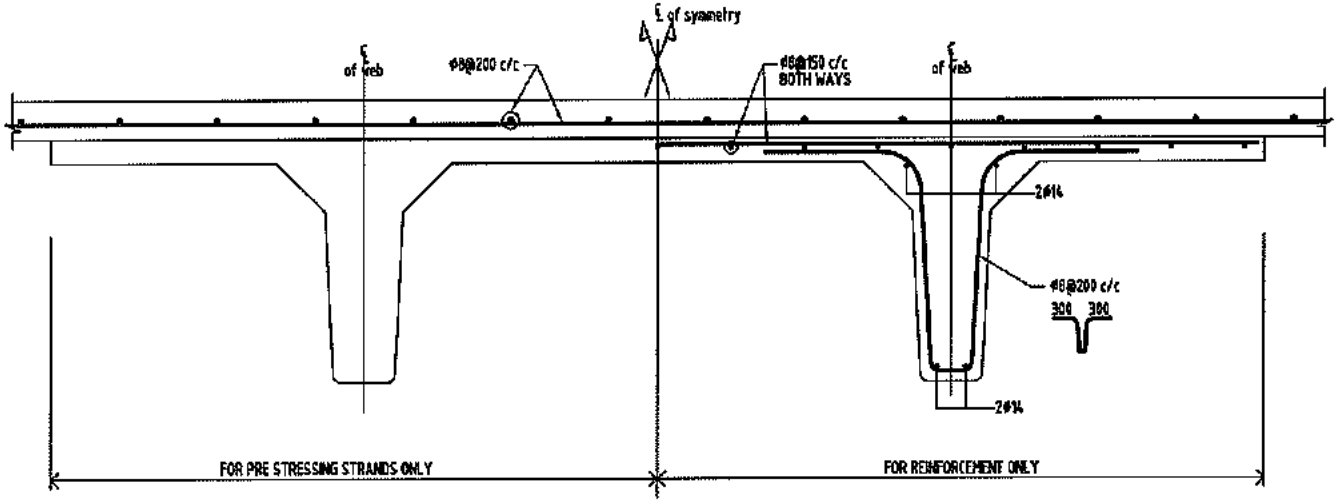
$V_{Rd,c}$ = **0.54**x1000x(225-50-5)
= **91,800 N > 89.1 kN. Hence, Safe.**

Design of Strip Footing Under Internal Walls:- (Sheet – 24)

Loads = 5x0.2x25 + 20 = 45 kN/m.
Providing 0.7m wide footing with the same reinforcement details as for footing under external walls will be safe.
Bearing pressure on soil = 45/0.7 = 64.5 kN/m^2. < 130 kN/m^2. Safe.



SECTION 1-1
(SHOWING DIMENSIONS)

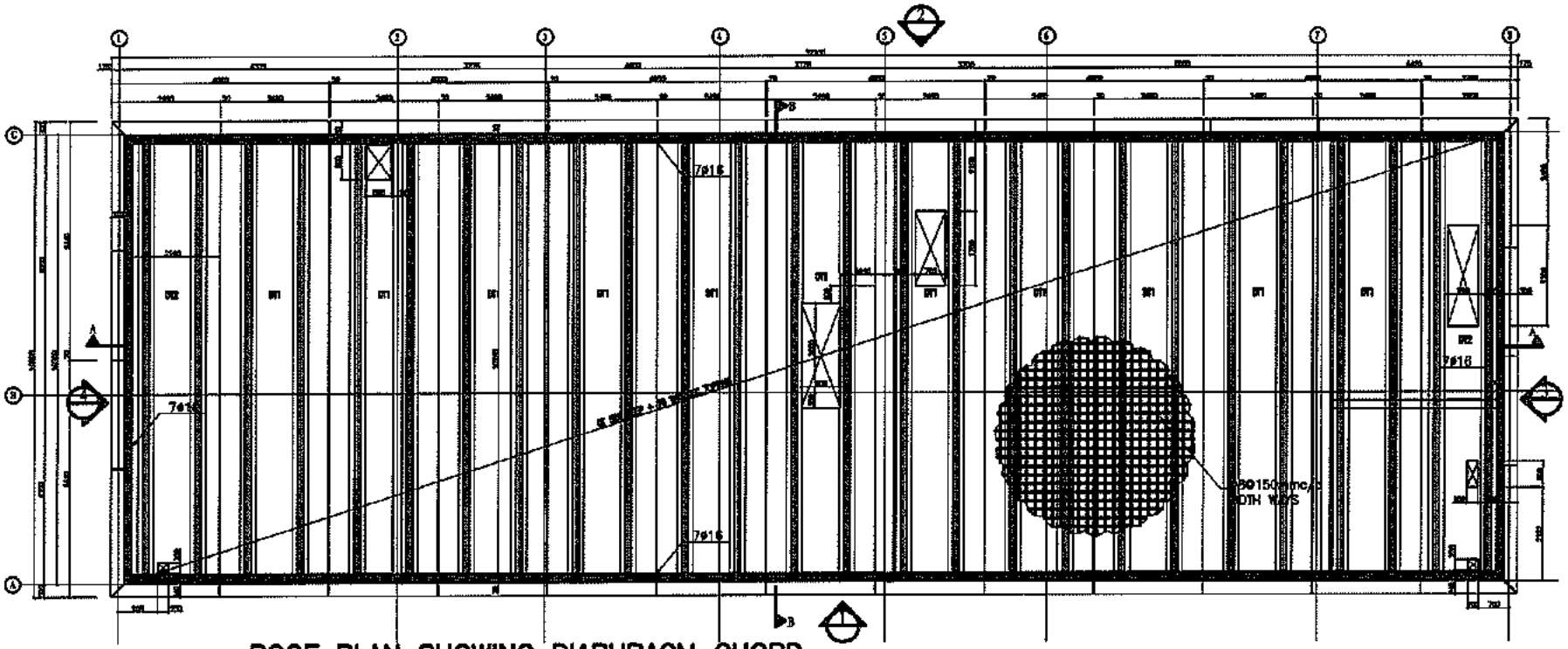


SECTION 1-1
(SHOWING R/F. & STRANDS)

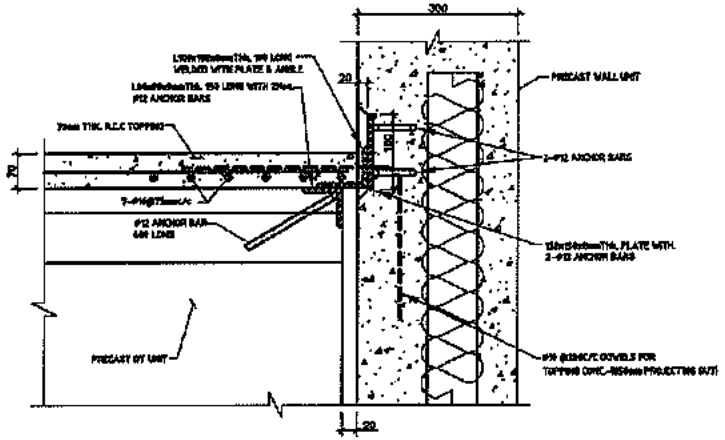
PRECAST CONCRETE `DT550' STANDARD

SHEIKH JABER AL AHMAD AL SABAH
CAUSEWAY PROJECT (MAIN LINK)
CONTRACT RA/140
SUBSTATION FACILITIES

SHEET 16

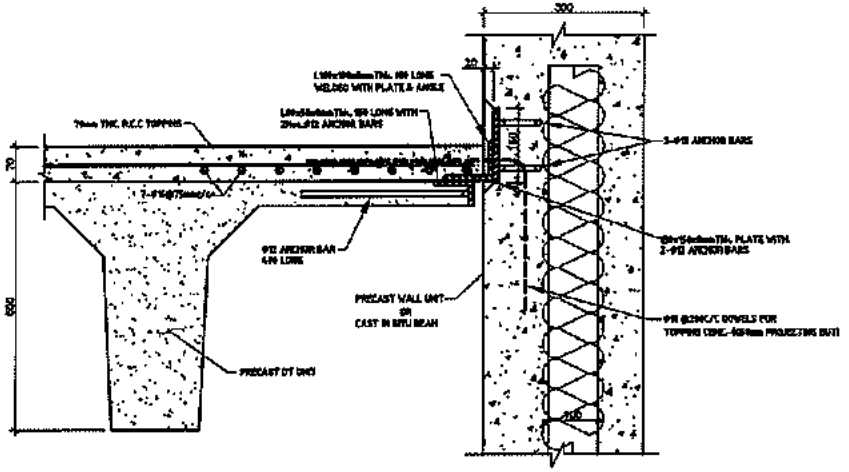


ROOF PLAN SHOWING DIAPHRAGM CHORD REINFORCEMENT IN STRUCTURAL TOPPING CONCRETE



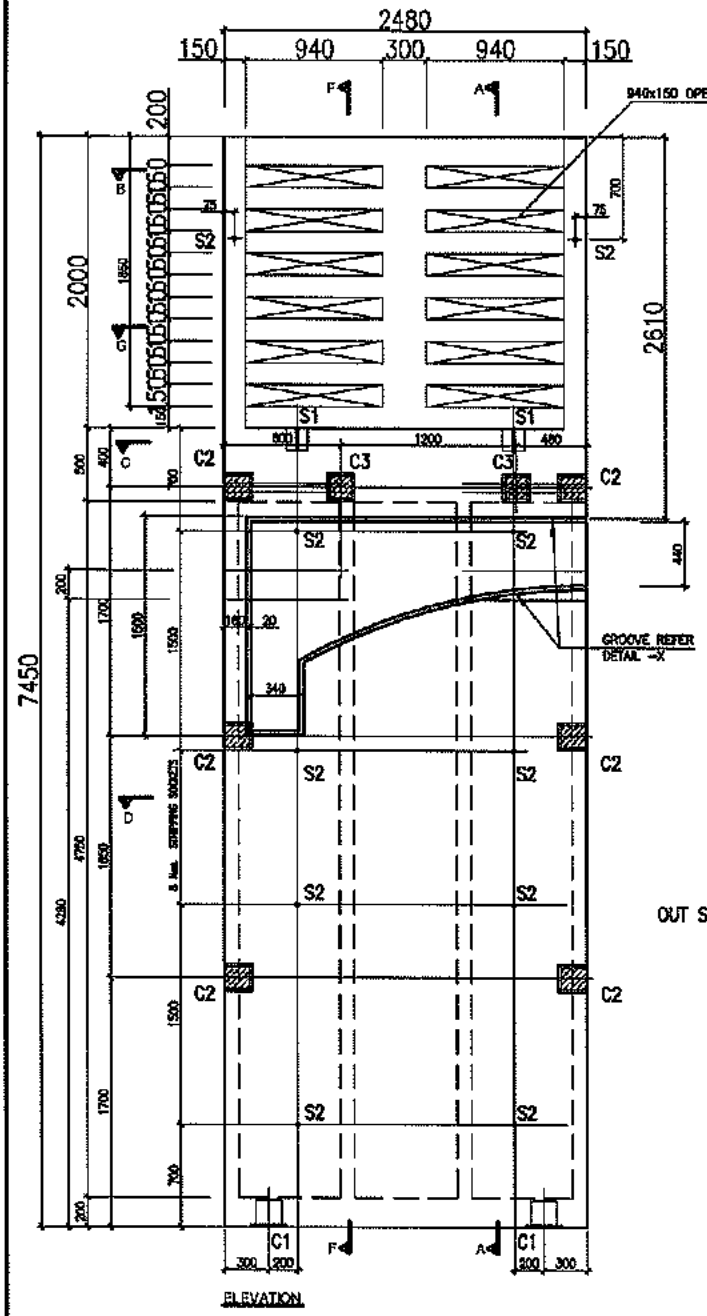
SECTION 1-1

SECTION SHOWING 'DT' TO WALL CONNECTION

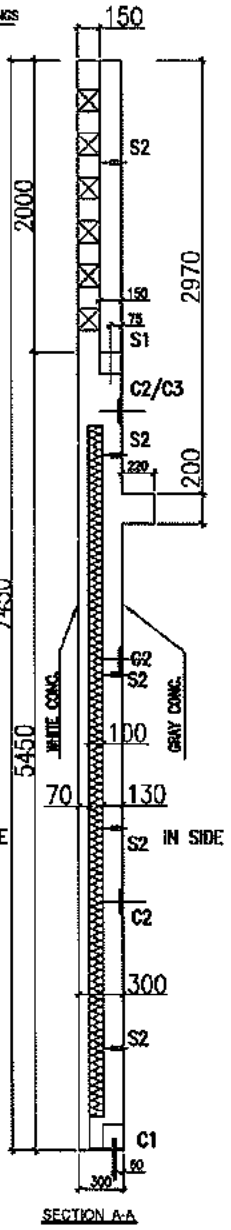


SECTION 2-2

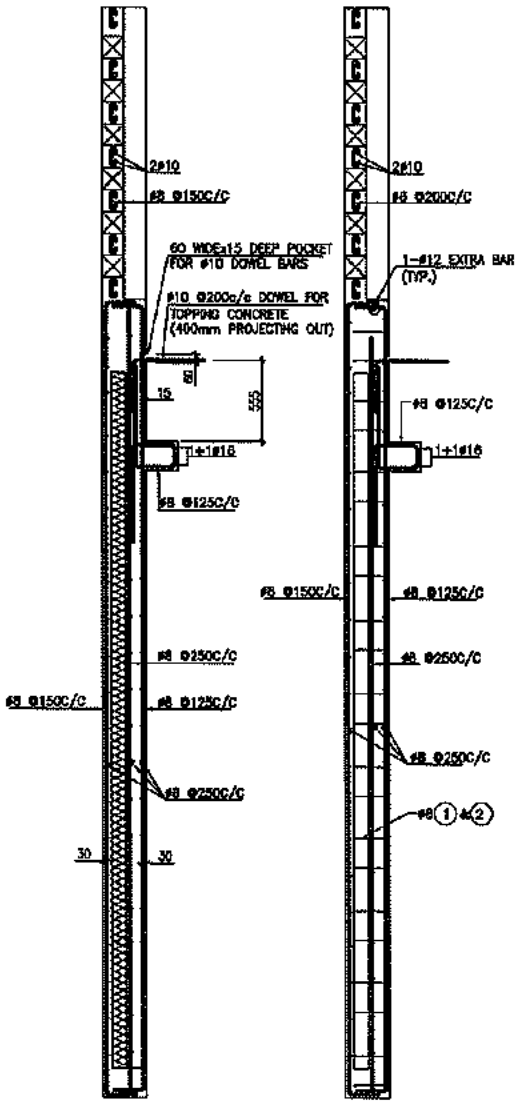
SECTION SHOWING 'DT' TO WALL CONNECTION



ELEVATION

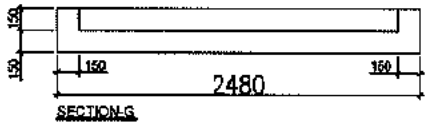


SECTION A-A

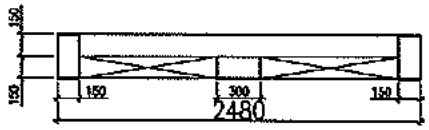


SECTION A-A (SHOWING REINFORCEMENT)

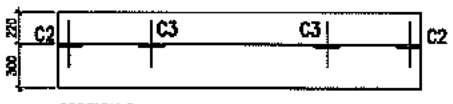
SECTION E-E (SHOWING REINFORCEMENT)



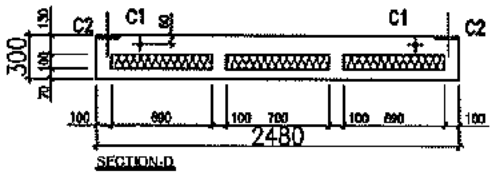
SECTION-G



SECTION-B

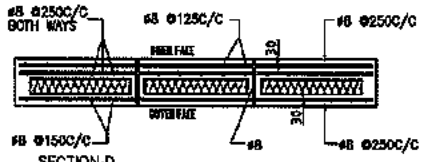


SECTION-C

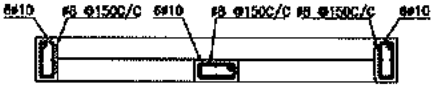


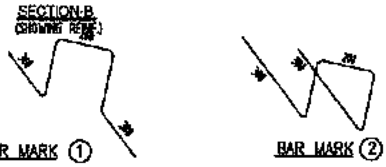
SECTION-D
EXTERNAL WALL UNIT

C1- 2 No CONNECTION
C2- 6 No CONNECTION
C3- 2 No CONNECTION
S1- 2 No LIFTING HOOKS IN RECESS
S2- 10 No STRIPPING SOCKETS



SECTION-D (SHOWING REINF.)





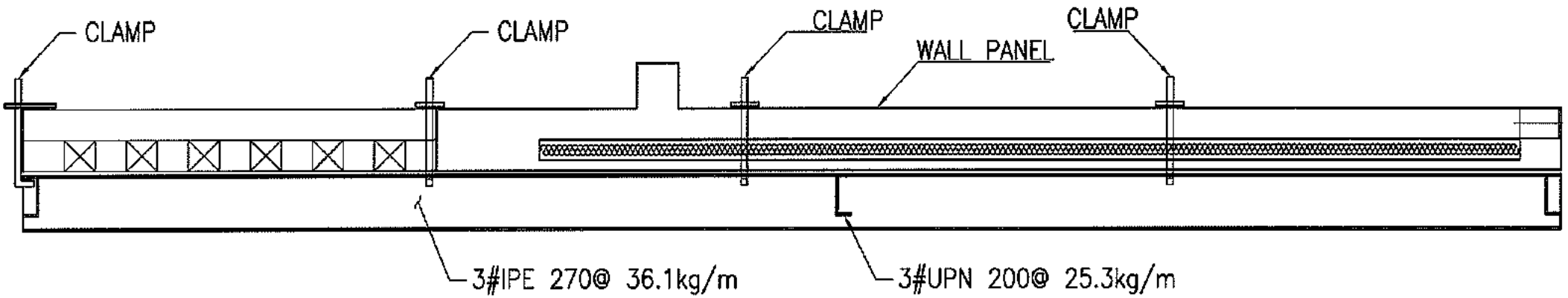
SECTION-B (SHOWING REINF.)

BAR MARK ①
FOR INTERMEDIATE RIBS

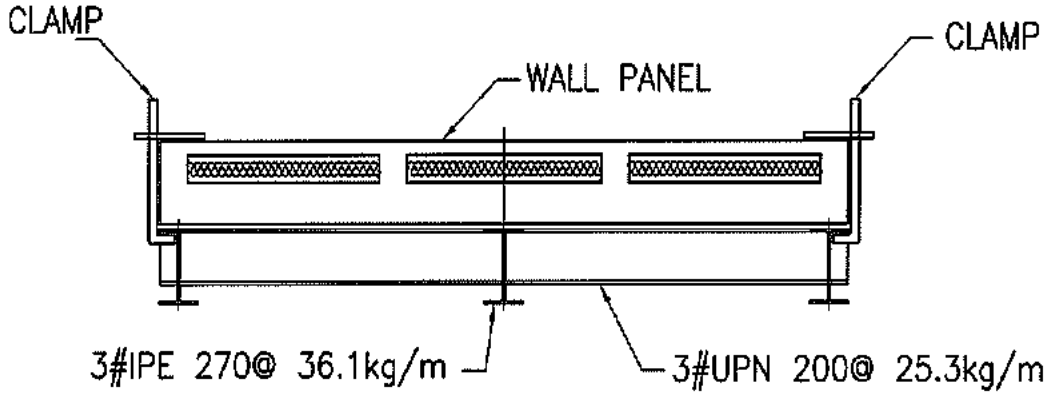
BAR MARK ②
FOR END RIBS

ALL INSERT PLATES AND ANGLES SHALL BE MILD STEEL RED OXIDE PAINTED.

SHEET 18

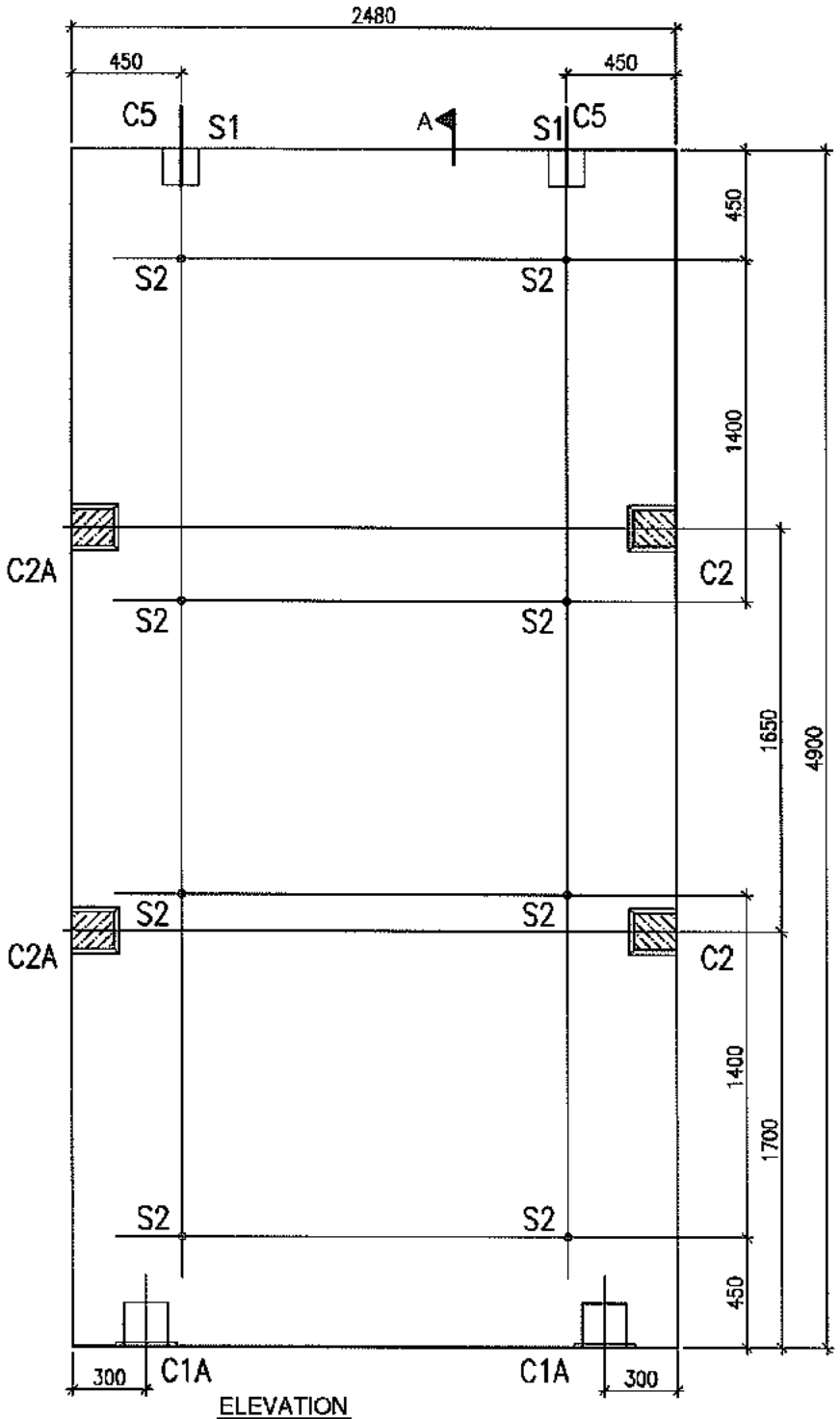


LONGITUDINAL SECTION



CROSS- SECTION

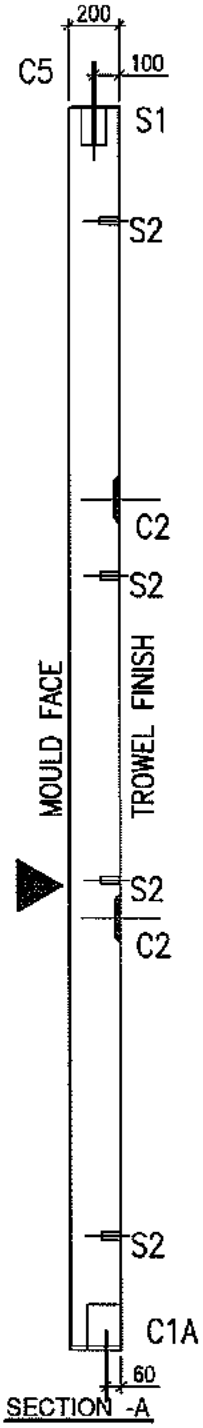
STEEL FRAME FOR TILTING WALL UNITS



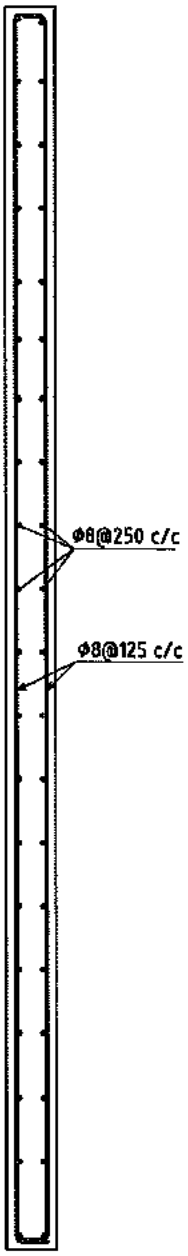
ELEVATION

PLAN

INTERNAL WALL UNIT



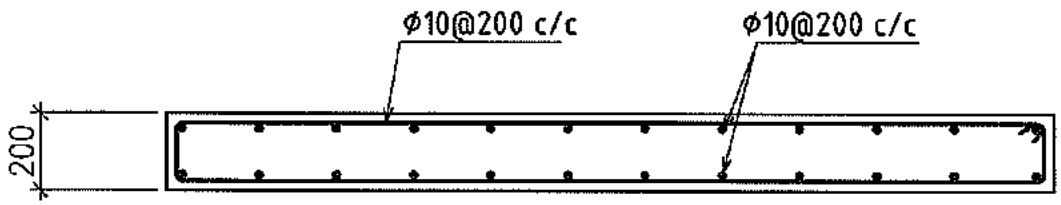
SECTION -A



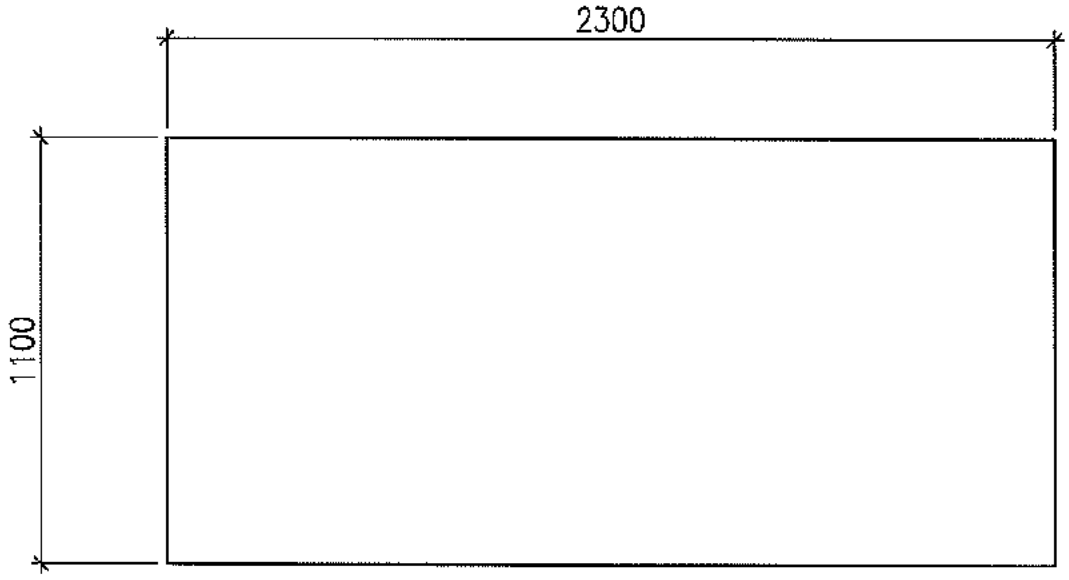
SECTION-A
(REINFORCEMENT DET. TYP)

C1A– 2 No CONNECTION
C2– 2 No CONNECTION
C2A– 2 No CONNECTION
C5– 2 No CONNECTION
S1– 2 No LIFTING HOOKS IN RECESS
S2– 8 No STRIPPING SOCKETS

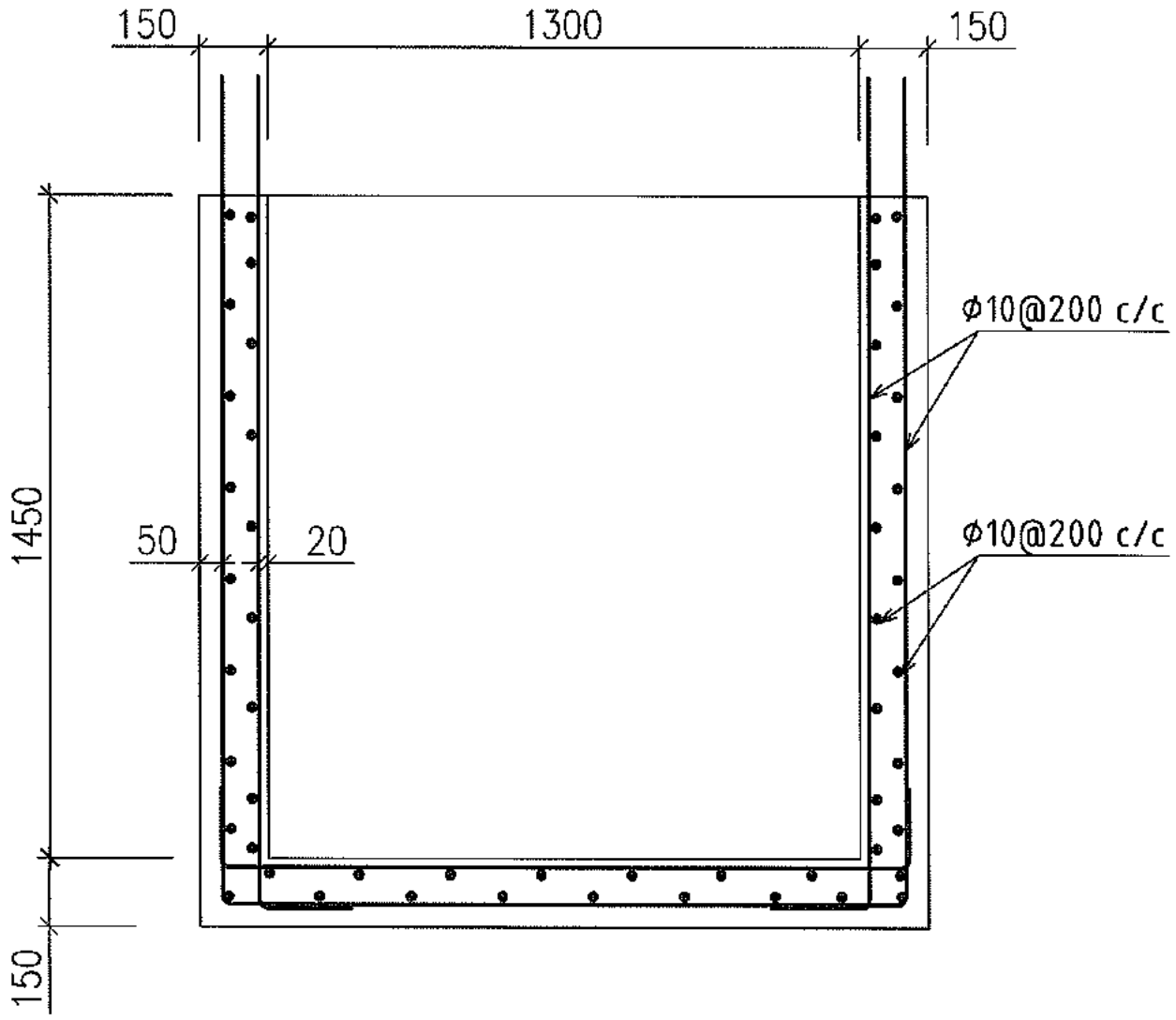
SHEET 20



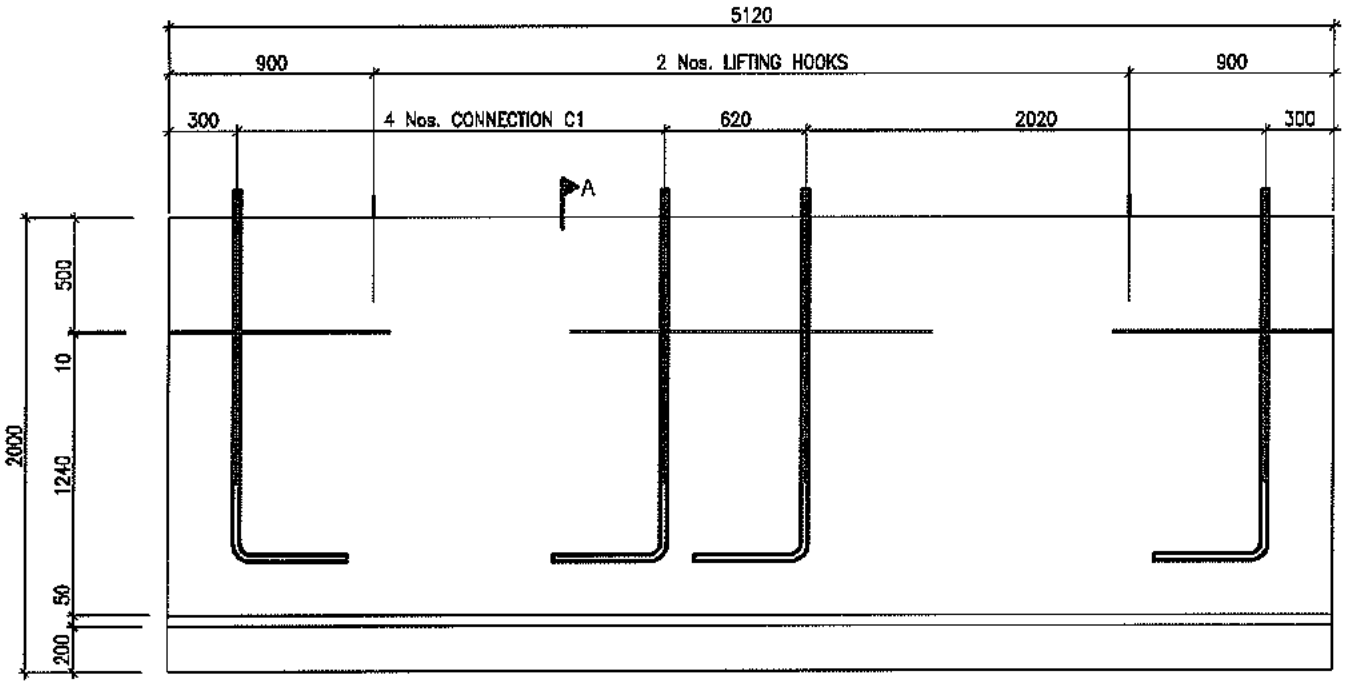
SECTION



TRANSFORMER SUPPORT SLAB UNIT



SHEET 22



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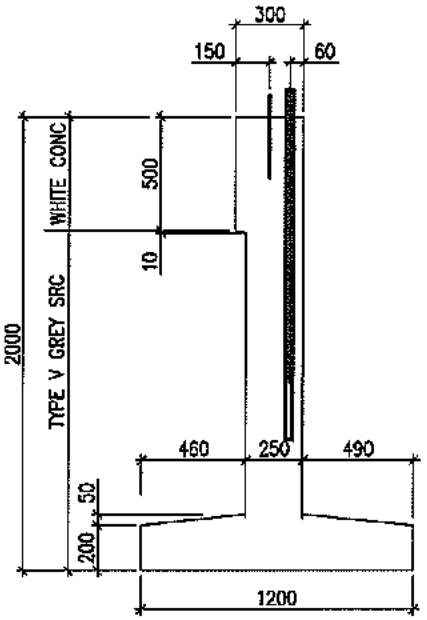
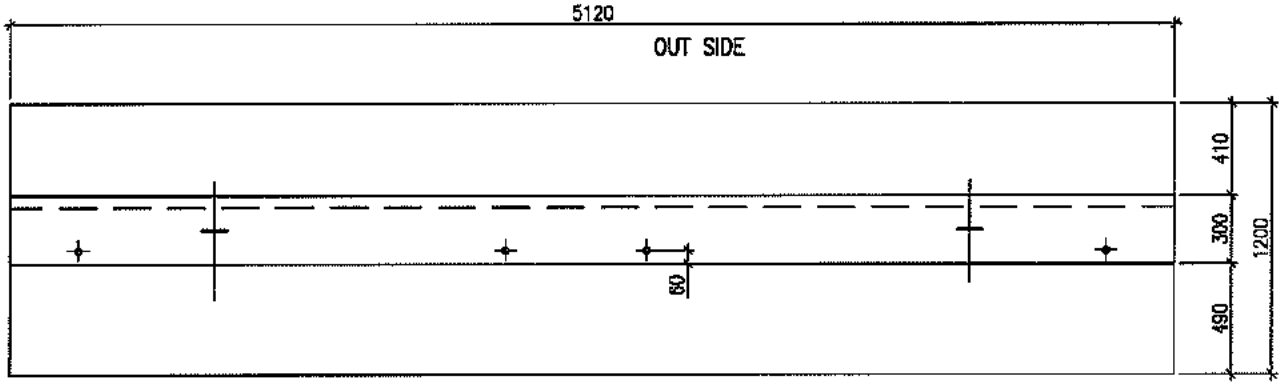
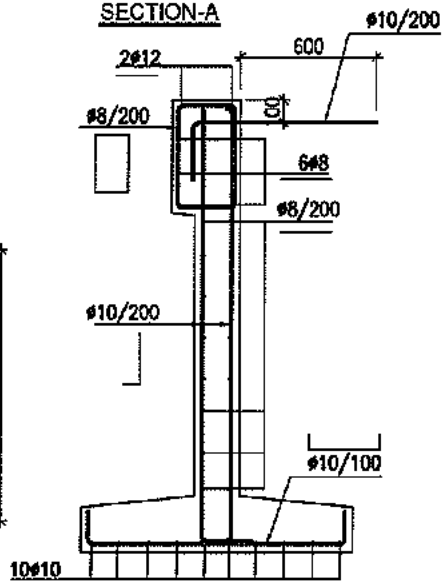


SECTION-A



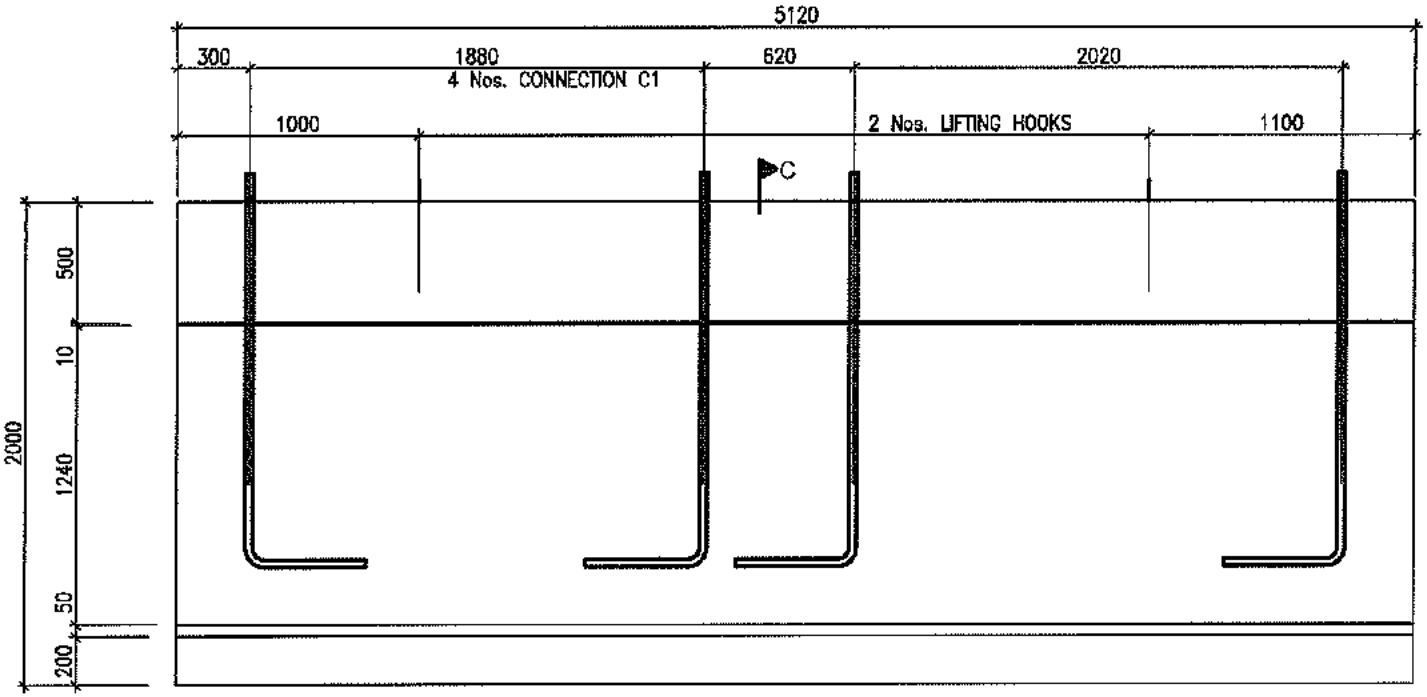
PLAN

EXTERNAL FOOTING



SECTION-A
SHOWING REINF.

SHEET 23



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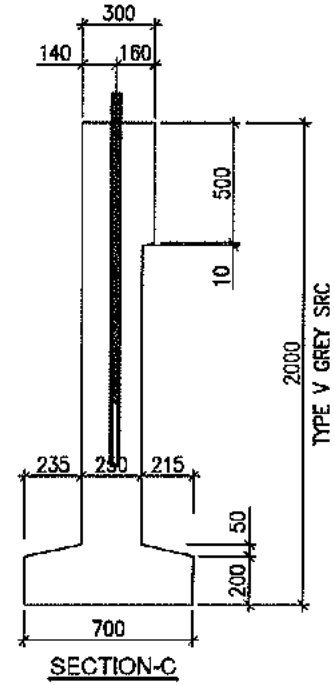
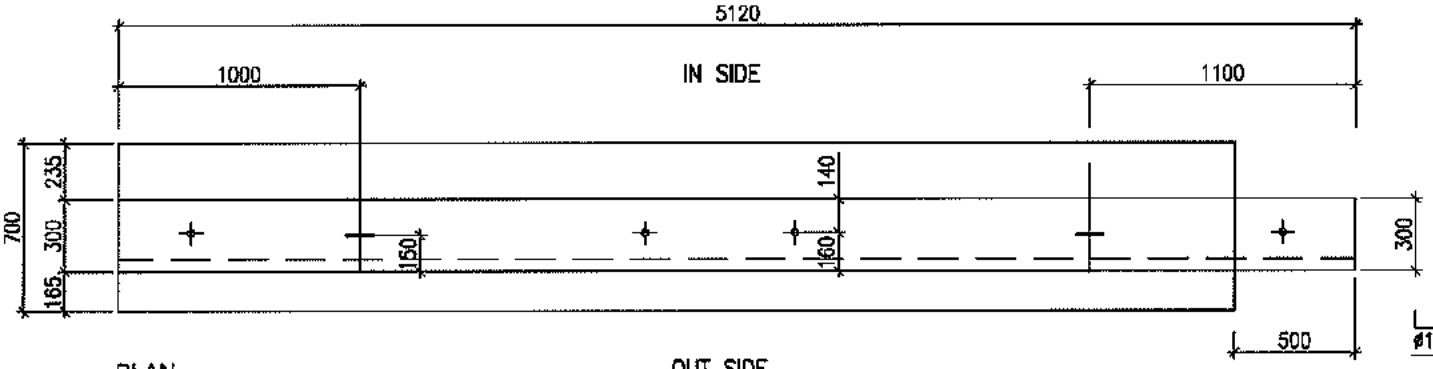


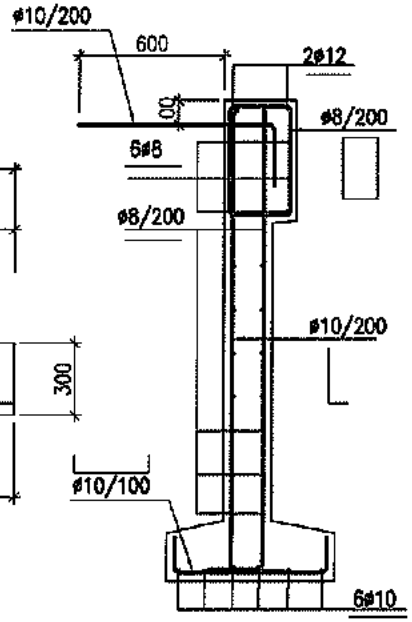
SECTION-C



PLAN

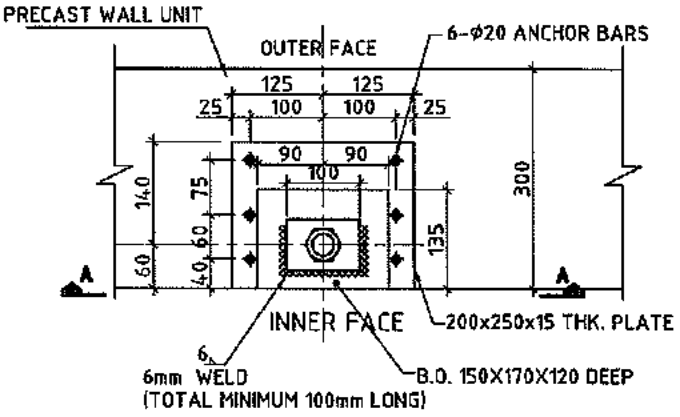
OUT SIDE

INTERNAL FOOTING

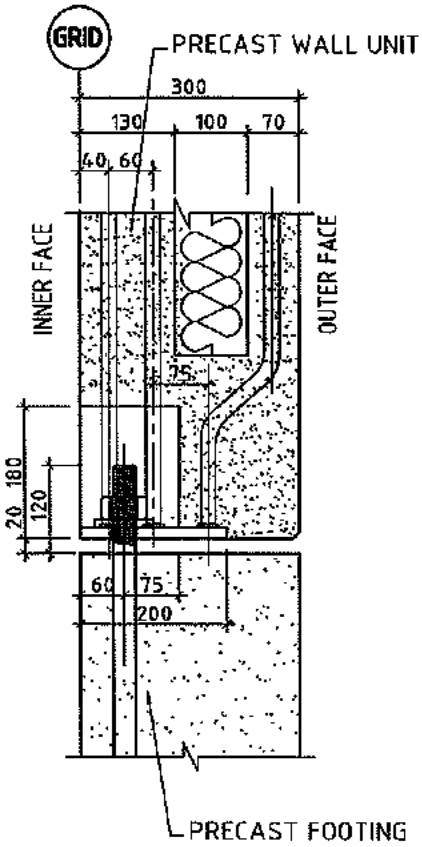


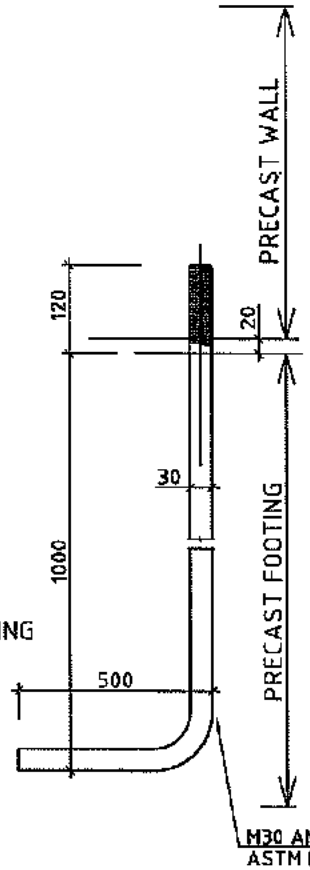
SECTION-C
SHOWING REINF.

SHEET 24

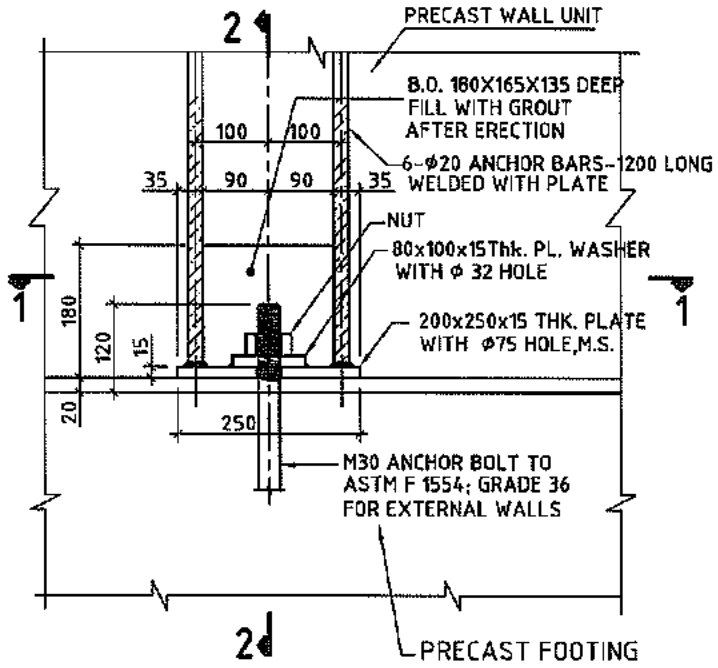


SECTION 1-1





SECTION 2-2

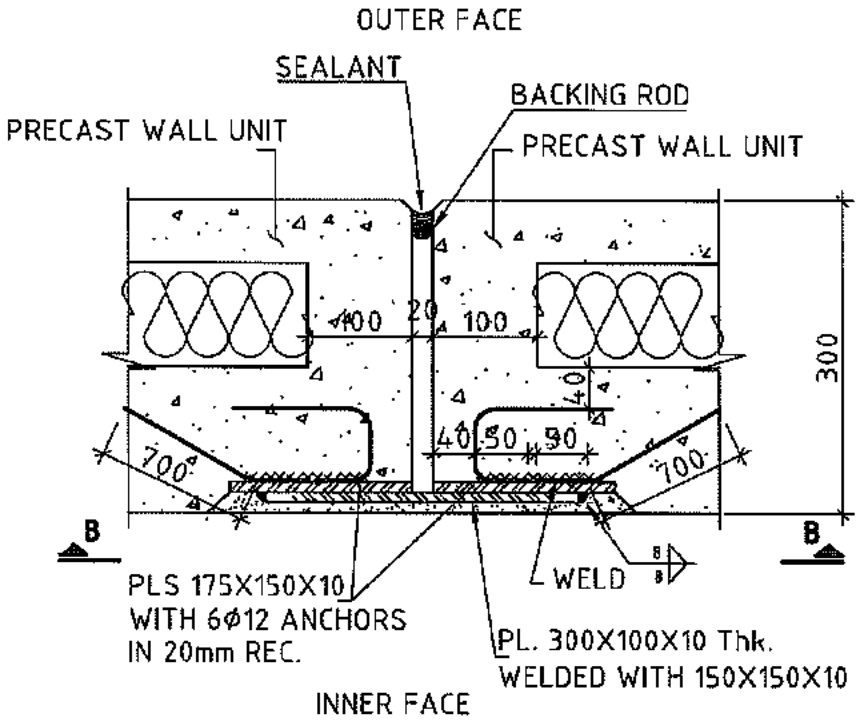


VIEW A-A

CONNECTION-C1

(FOOTING TO OUTER WALL)

SHEET-25



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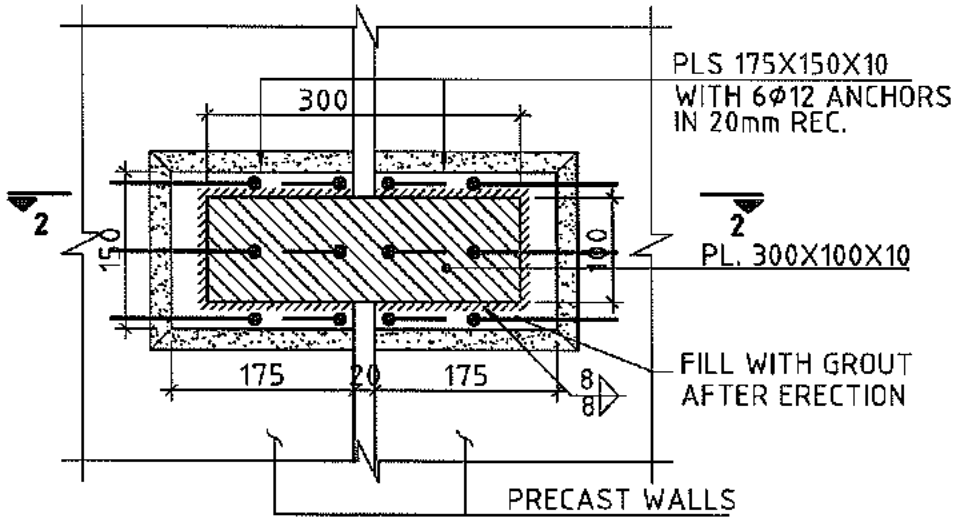
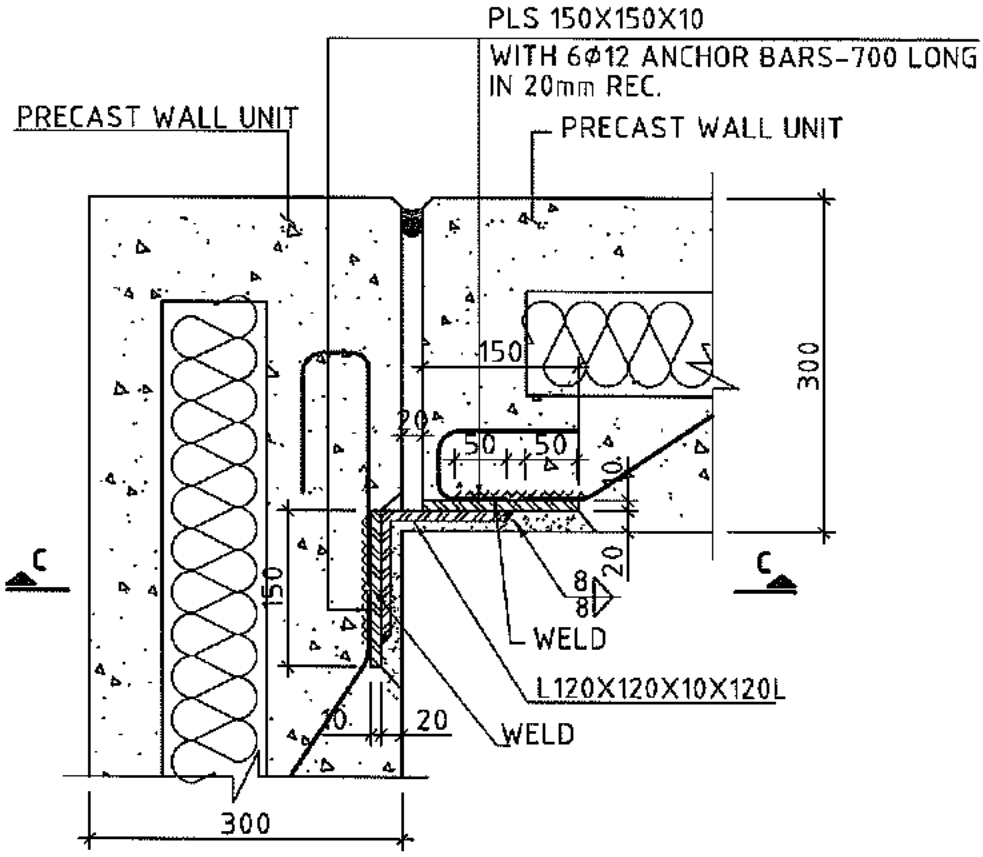


VIEW B-B

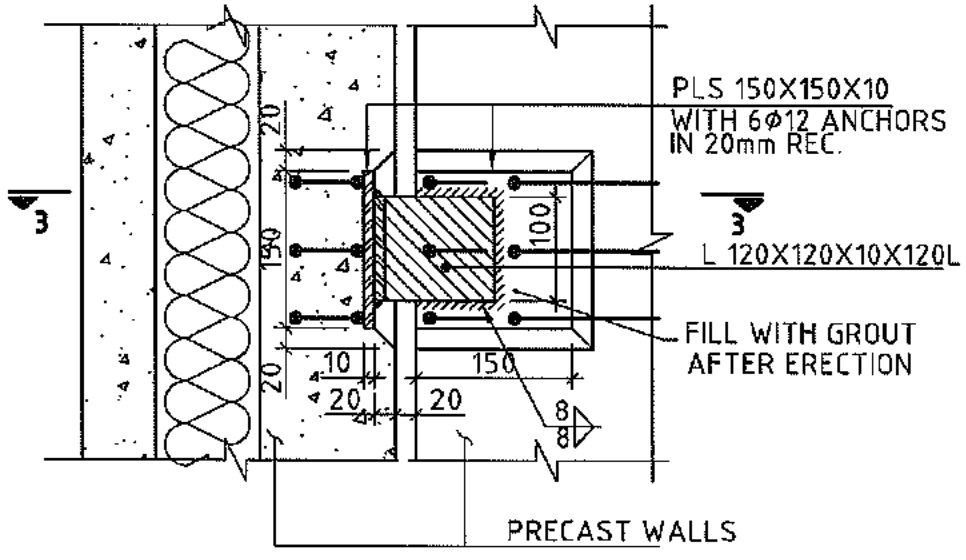
CONNECTION-C2

(WALL TO WALL)

SHEET-26



SECTION 3-3

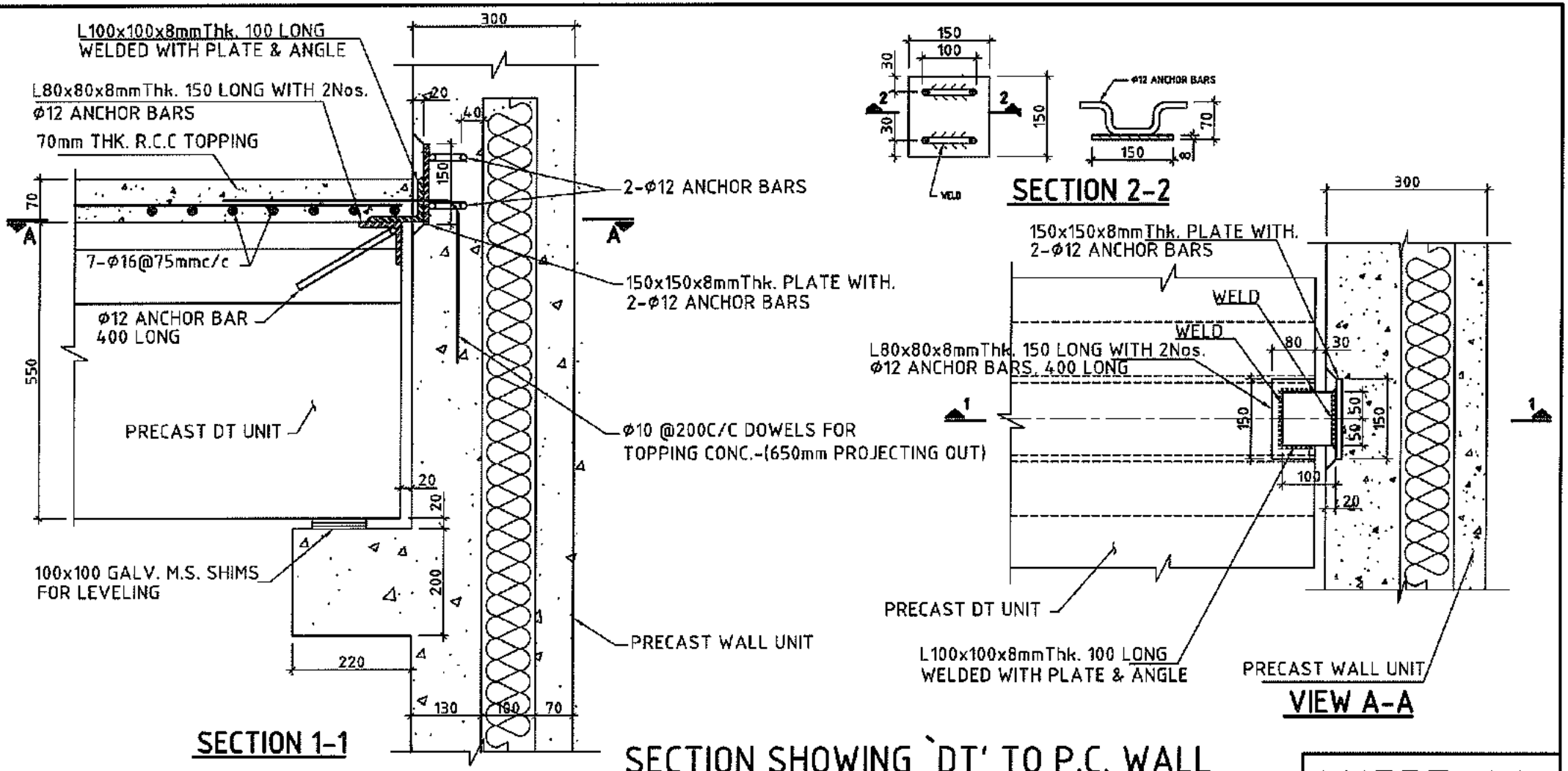


VIEW C-C

CONNECTION-C2A

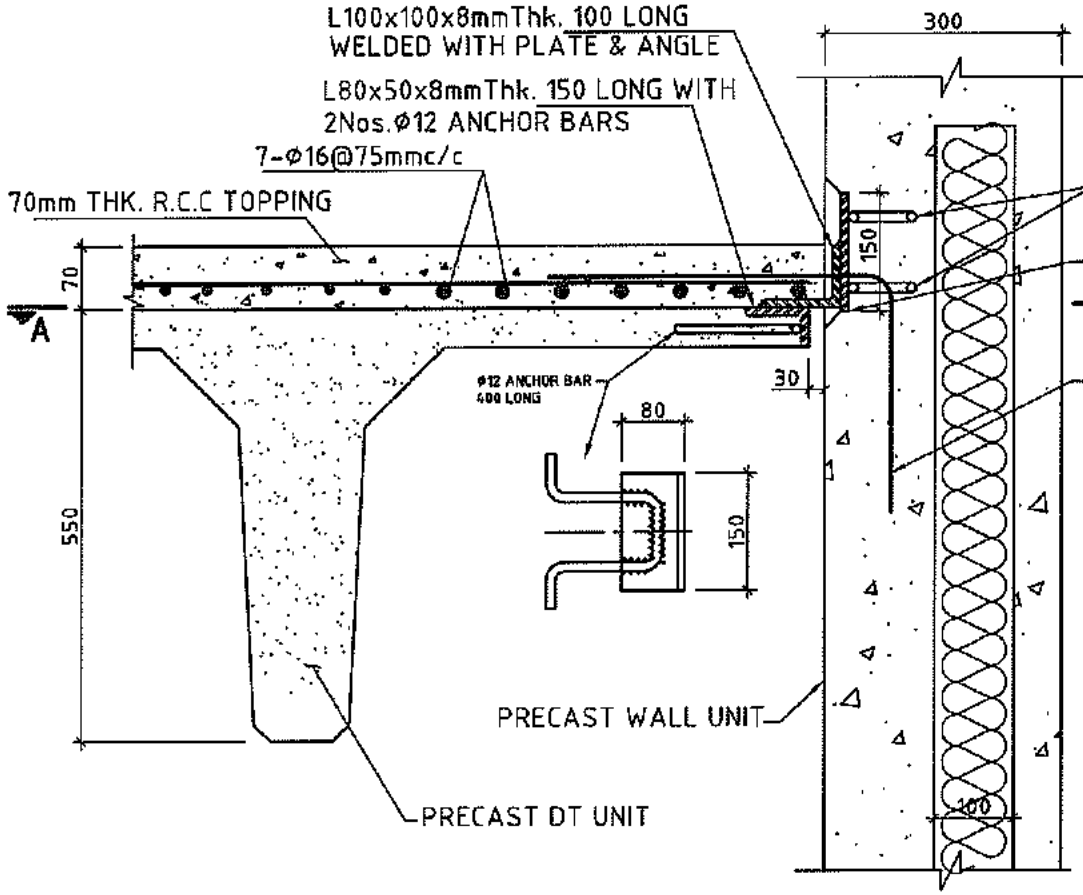
(AT CORNER)

SHEET-27

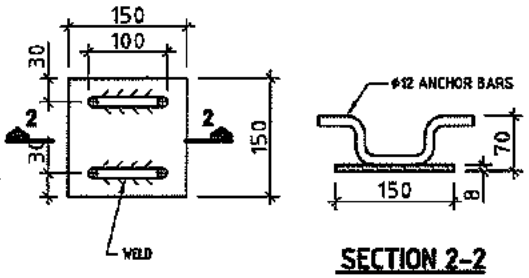


SECTION SHOWING `DT' TO P.C. WALL CONNECTION-C3

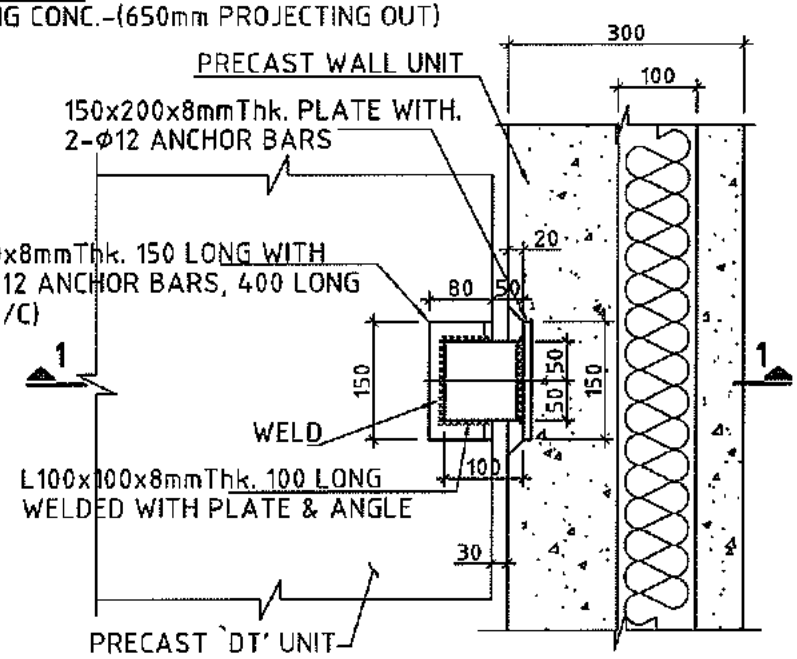
SHEET-28



SECTION 1-1



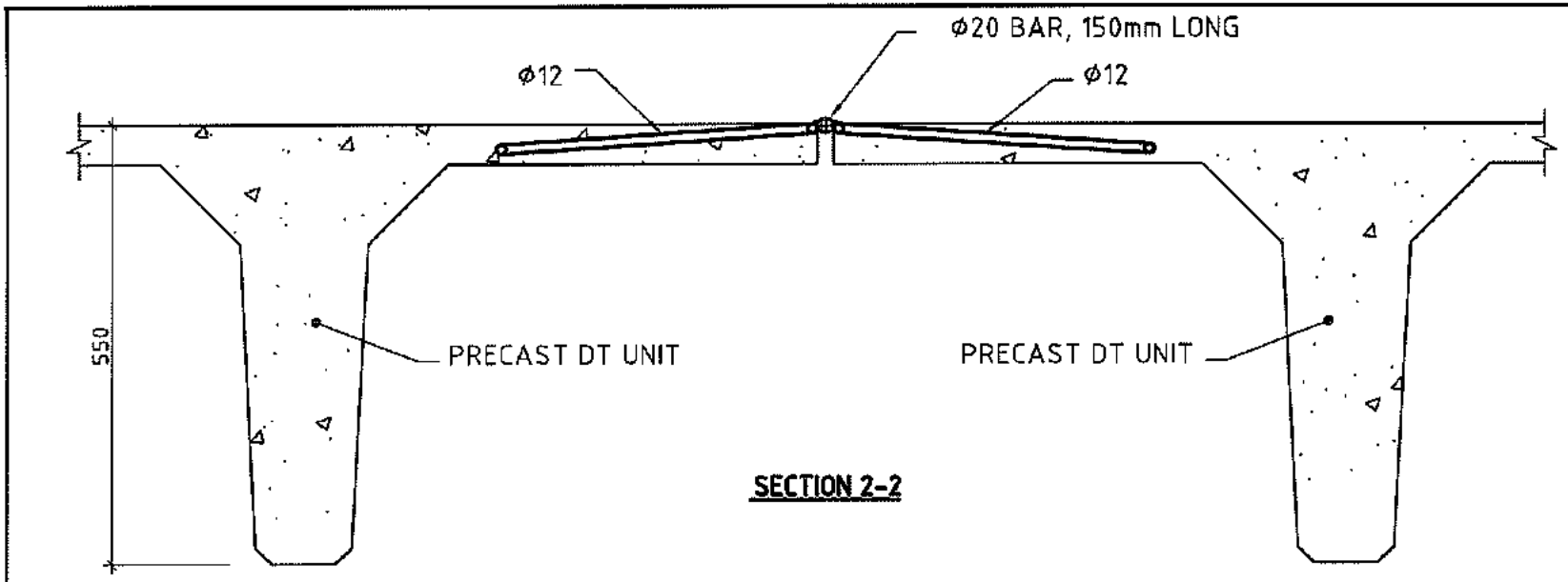
SECTION 2-2



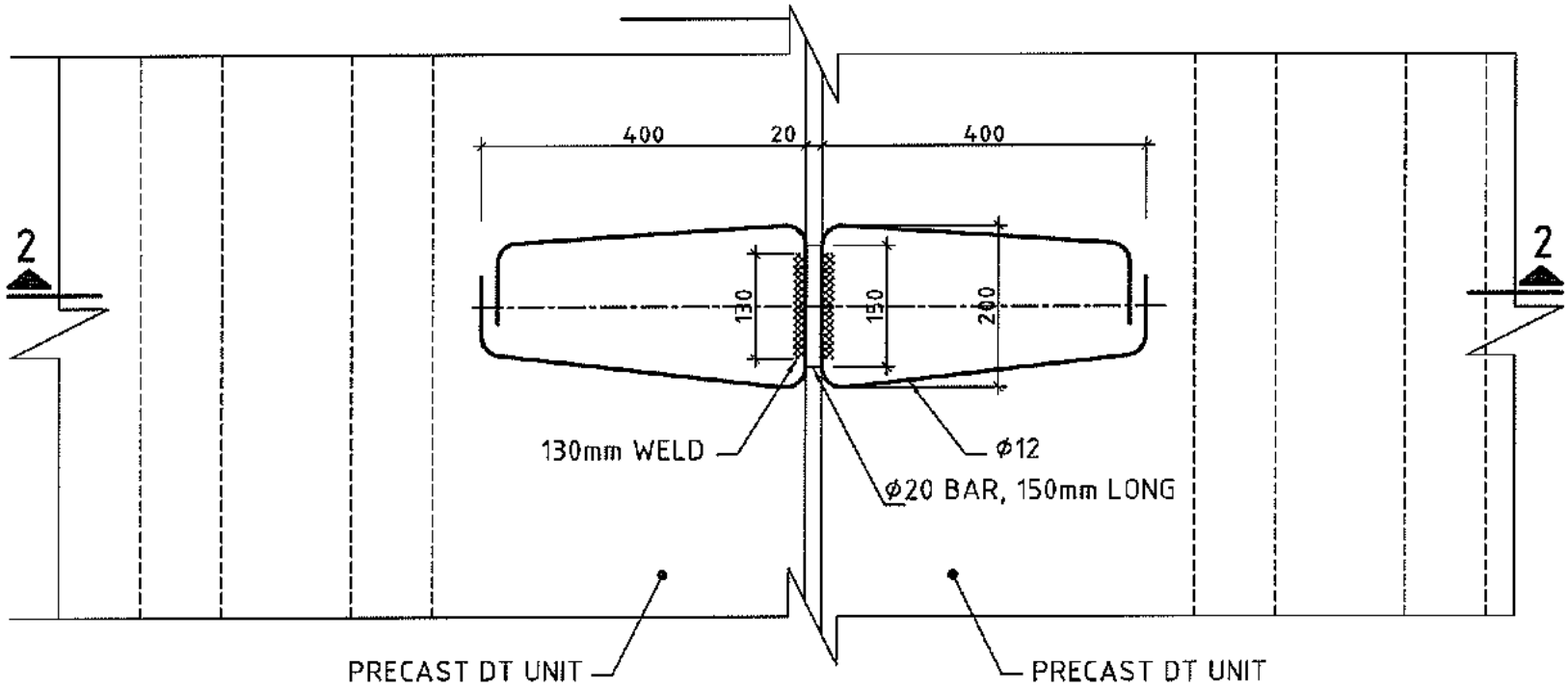
VIEW A-A

SECTION SHOWING `DT' SEATING & `DT' TO WALL CONNECTION-C3A

SHEET-29

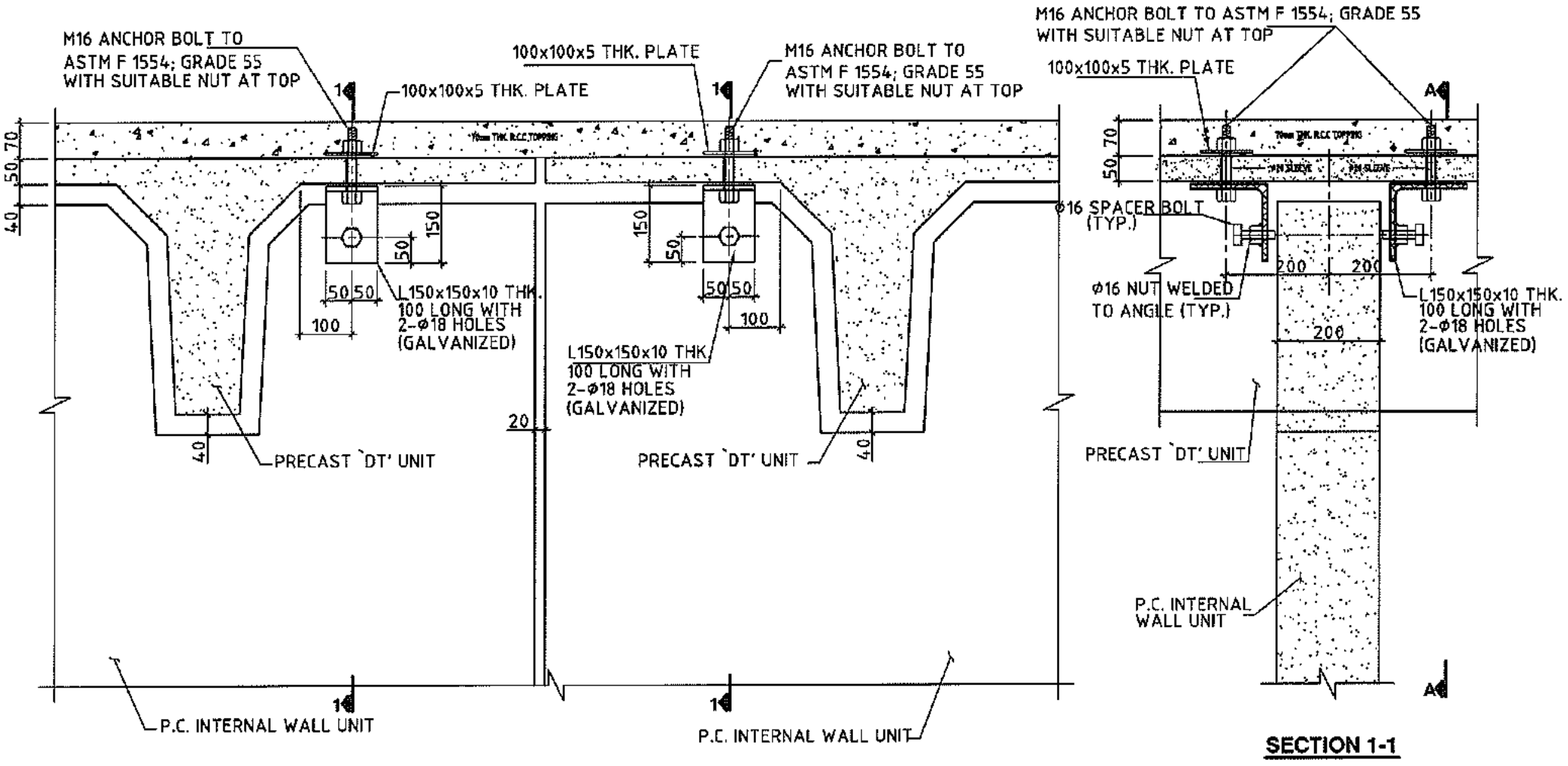


SECTION 2-2



PART PLAN
DT TO DT CONNECTION-C4

SHEET-30



VIEW A-A

CONNECTION BETWEEN INTERNAL WALL TO `DT' - C5

SHEET-31

EN 1991-1.1	Densities, self-weight and imposed loads
EN 1991-1. 2	Fire actions
EN 1991-1.3	Snow loads
EN 1991-1.4	Wind loads
EN 1991-1.5	Thermal actions
EN 1991-1.6	Actions during execution
EN 1991-1.7	Accidental actions due to impact and explosions
EN 1991-2	Traffic loads on bridges
EN 1991-3	Actions induced by cranes and other machinery
EN 1991-4	Actions in silos and tanks

Note 2: Actions specific to this Standard are given in the relevant sections.

Note 3: Actions from earth and water pressure may be obtained from EN 1997.

Note 4: When differential movements are taken into account, appropriate estimate values of predicted movements may be used.

Note 5: Other actions, when relevant, may be defined in the design specification for a particular project.

2.3.1.2 Thermal effects

(1) Thermal effects should be taken into account when checking serviceability limit states.

(2) Thermal effects should be considered for ultimate limit states only where they are significant (e.g. fatigue conditions, in the verification of stability where second order effects are of importance, etc). In other cases they need not be considered, provided that the ductility and rotation capacity of the elements are sufficient.

(3) Where thermal effects are taken into account they should be considered as variable actions and applied with a partial factor and ψ factor.

Note: The ψ factor is defined in the relevant annex of EN 1990 and EN 1991-1-5.

2.3.1.3 Differential settlements/movements

(1) Differential settlements/movements of the structure due to soil subsidence should be classified as a permanent action, G_{set} which is introduced as such in combinations of actions. In general, G_{set} is represented by a set of values corresponding to differences (compared to a reference level) of settlements/movements between individual foundations or part of foundations, $d_{set,i}$ (i denotes the number of the individual foundation or part of foundation).

Note: Where differential settlements are taken into account, appropriate estimate values of predicted settlements may be used.

(2) The effects of differential settlements should generally be taken into account for the verification for serviceability limit states.

(3) For ultimate limit states they should be considered only where they are significant (e.g. fatigue conditions, in the verification of stability where second order effects are of importance, etc). In other cases for ultimate limit states they need not be considered, provided that the ductility and rotation capacity of the elements are sufficient.

(4) Where differential settlements are taken into account a partial safety factor for settlement effects should be applied.

Table 3.1 Strength and deformation characteristics for concrete

Strength classes for concrete															Analytical relation / Explanation
f_{ck} (MPa)	12	16	20	25	30	35	40	45	50	55	60	70	80	90	
$f_{ck,cube}$ (MPa)	15	20	25	30	37	45	50	55	60	67	75	85	95	105	2.8
f_{cm} (MPa)	20	24	28	33	38	43	48	53	58	63	68	78	88	98	$f_{cm} = f_{ck}+8$(MPa)
f_{ctm} (MPa)	1,6	1,9	2,2	2,6	2,9	3,2	3,5	3,8	4,1	4,2	4,4	4,6	4,8	5,0	$f_{ctm}=0,30\times f_{ck}^{(2/3)} \leq$C50/60 $f_{ctm}=2,12\cdot\ln(1+(f_{cm}/10))$ > C50/60
$f_{ctk,\,0,05}$ (MPa)	1,1	1,3	1,5	1,8	2,0	2,2	2,5	2,7	2,9	3,0	3,1	3,2	3,4	3,5	$f_{ctk;0,05} = 0,7\times f_{ctm}$ 5% fractile
$f_{ctk,0,95}$ (MPa)	2,0	2,5	2,9	3,3	3,8	4,2	4,6	4,9	5,3	5,5	5,7	6,0	6,3	6,6	$f_{ctk;0,95} = 1,3\times f_{ctm}$ 95% fractile
E_{cm} (GPa)	27	29	30	31	33	34	35	36	37	38	39	41	42	44	$E_{cm} = 22[(f_{cm})/10]^{0,3}$ (f_{cm} in MPa)
ε_{c1} (‰)	1,8	1,9	2,0	2,1	2,2	2,25	2,3	2,4	2,45	2,5	2,6	2,7	2,8	2,8	see Figure 3.2 (AC) $\varepsilon_{c1}(‰) = 0,7\, f_{cm}^{0,31} \leq 2,8$ (AC)
ε_{cu1} (‰)	3,5									3,2	3,0	2,8	2,8	2,8	see Figure 3.2 for $f_{ck} \geq$ 50 Mpa $\varepsilon_{cu1}(‰)=2,8+27[(98-f_{cm})/100]^4$
ε_{c2} (‰)	2,0									2,2	2,3	2,4	2, 5	2,6	see Figure 3.3 for $f_{ck} \geq$ 50 Mpa $\varepsilon_{c2}(‰)=2,0+0,085(f_{ck}-50)^{0,53}$
ε_{cu2} (‰)	3,5									3,1	2,9	2,7	2,6	2,6	see Figure 3.3 for $f_{ck} \geq$ 50 Mpa $\varepsilon_{cu2}(‰)=2,6+35[(90-f_{ck})/100]^4$
n	2,0									1,75	1,6	1,45	1,4	1,4	for $f_{ck} \geq$ 50 Mpa $n=1,4+23,4[(90-f_{ck})/100]^4$
ε_{c3} (‰)	1,75									1,8	1,9	2,0	2,2	2,3	see Figure 3.4 for $f_{ck} \geq$ 50 Mpa $\varepsilon_{c3}(‰)=1,75+0,55[(f_{ck}-50)/40]$
ε_{cu3} (‰)	3,5									3,1	2,9	2,7	2,6	2,6	see Figure 3.4 for $f_{ck} \geq$ 50 Mpa $\varepsilon_{cu3}(‰)=2,6+35[(90-f_{ck})/100]^4$

(2) Other idealised stress-strain relations may be applied, if they adequately represent the behaviour of the concrete considered.

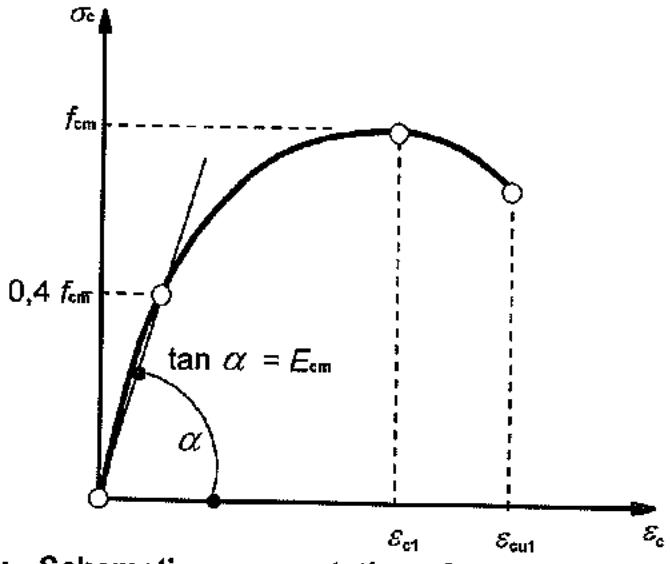


Figure 3.2: Schematic representation of the stress-strain relation for structural analysis (the use $0{,}4f_{cm}$ for the definition of E_{cm} is approximate).

3.1.6 Design compressive and tensile strengths

(1)P The value of the design compressive strength is defined as

$$f_{cd} = \alpha_{cc} f_{ck} / \gamma_C \qquad (3.15)$$

where:

γ_C is the partial safety factor for concrete, see 2.4.2.4, and

α_{cc} is the coefficient taking account of long term effects on the compressive strength and of unfavourable effects resulting from the way the load is applied.

Note: The value of α_{cc} for use in a Country should lie between 0,8 and 1,0 and may be found in its National Annex. The recommended value is 1.

(2)P The value of the design tensile strength, f_{ctd}, is defined as

$$f_{ctd} = \alpha_{ct} f_{ctk,0,05} / \gamma_C \qquad (3.16)$$

where:

γ_C is the partial safety factor for concrete, see 2.4.2.4, and

α_{ct} is a coefficient taking account of long term effects on the tensile strength and of unfavourable effects, resulting from the way the load is applied.

Note: The value of α_{ct} for use in a Country may be found in its National Annex. The recommended value is 1,0.

3.1.7 Stress-strain relations for the design of cross-sections

(1) For the design of cross-sections, the following stress-strain relationship may be used, see Figure 3.3 (compressive strain shown positive):

$$\sigma_c = f_{cd}\left[1-\left(1-\frac{\varepsilon_c}{\varepsilon_{c2}}\right)^n\right] \quad \text{for} \quad 0 \le \varepsilon_c \le \varepsilon_{c2} \tag{3.17}$$

$$\sigma_c = f_{cd} \quad \text{for} \quad \varepsilon_{c2} \le \varepsilon_c \le \varepsilon_{cu2} \tag{3.18}$$

where:

n is the exponent according to Table 3.1

ε_{c2} is the strain at reaching the maximum strength according to Table 3.1

ε_{cu2} is the ultimate strain according to Table 3.1

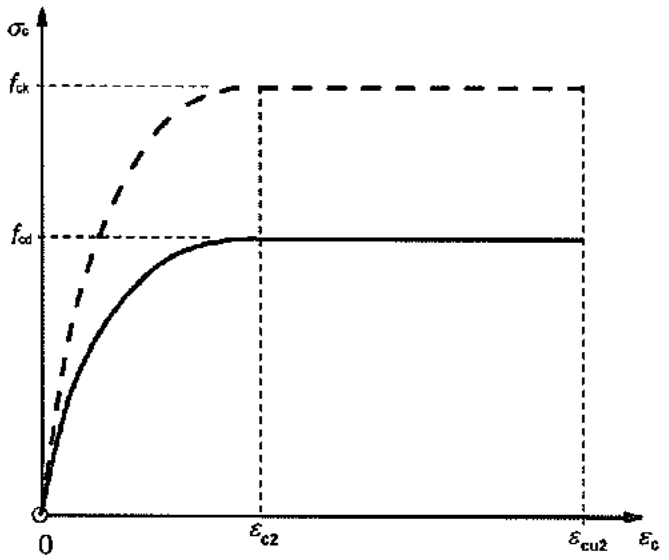


Figure 3.3: Parabola-rectangle diagram for concrete under compression.

(2) Other simplified stress-strain relationships may be used if equivalent to or more conservative than the one defined in (1), for instance bi-linear according to Figure 3.4 (compressive stress and shortening strain shown as absolute values) with values of ε_{c3} and ε_{cu3} according to Table 3.1.

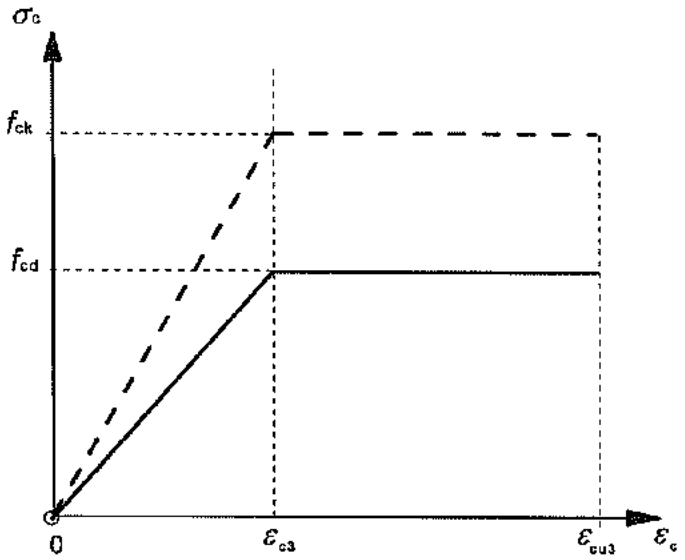


Figure 3.4: Bi-linear stress-strain relation.

(3) A rectangular stress distribution (as given in Figure 3.5) may be assumed. The factor λ,

defining the effective height of the compression zone and the factor η, defining the effective strength, follow from:

$\lambda = 0{,}8$ for $f_{ck} \leq 50$ MPa (3.19)

$\lambda = 0{,}8 - (f_{ck} - 50)/400$ for $50 < f_{ck} \leq 90$ MPa (3.20)

and

$\eta = 1{,}0$ for $f_{ck} \leq 50$ MPa (3.21)

$\eta = 1{,}0 - (f_{ck} - 50)/200$ for $50 < f_{ck} \leq 90$ MPa (3.22)

Note: If the width of the compression zone decreases in the direction of the extreme compression fibre, the value ηf_{cd} should be reduced by 10%.

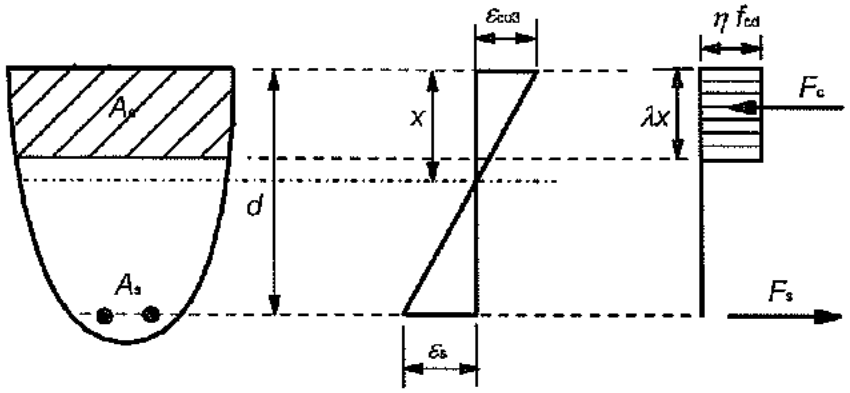


Figure 3.5: Rectangular stress distribution

3.1.8 Flexural tensile strength

(1) The mean flexural tensile strength of reinforced concrete members depends on the mean axial tensile strength and the depth of the cross-section. The following relationship may be used:

$$f_{ctm,fl} = \max \{(1{,}6 - h/1000) f_{ctm};\ f_{ctm}\} \quad (3.23)$$

where:

h is the total member depth in mm

f_{ctm} is the mean axial tensile strength following from Table 3.1.

The relation given in Expression (3.23) also applies for the characteristic tensile strength values.

3.1.9 Confined concrete

(1) Confinement of concrete results in a modification of the effective stress-strain relationship: higher strength and higher critical strains are achieved. The other basic material characteristics may be considered as unaffected for design.

(2) In the absence of more precise data, the stress-strain relation shown in Figure 3.6 (compressive strain shown positive) may be used, with increased characteristic strength and strains according to:

$$f_{ck,c} = f_{ck}\,(1{,}000 + 5{,}0\ \sigma_2/f_{ck}) \quad \text{for } \sigma_2 \leq 0{,}05 f_{ck} \quad (3.24)$$

5.8.2 General

(1)P This clause deals with members and structures in which the structural behaviour is significantly influenced by second order effects (e.g. columns, walls, piles, arches and shells). Global second order effects are likely to occur in structures with a flexible bracing system.

(2)P Where second order effects are taken into account, see (6), equilibrium and resistance shall be verified in the deformed state. Deformations shall be calculated taking into account the relevant effects of cracking, non-linear material properties and creep.

Note. In an analysis assuming linear material properties, this can be taken into account by means of reduced stiffness values, see 5.8.7.

(3)P Where relevant, analysis shall include the effect of flexibility of adjacent members and foundations (soil-structure interaction).

(4)P The structural behaviour shall be considered in the direction in which deformations can occur, and biaxial bending shall be taken into account when necessary.

(5)P Uncertainties in geometry and position of axial loads shall be taken into account as additional first order effects based on geometric imperfections, see 5.2.

(6) Second order effects may be ignored if they are less than 10 % of the corresponding first order effects. Simplified criteria are given for isolated members in 5.8.3.1 and for structures in 5.8.3.3.

5.8.3 Simplified criteria for second order effects

5.8.3.1 Slenderness criterion for isolated members

(1) As an alternative to 5.8.2 (6), second order effects may be ignored if the slenderness λ (as defined in 5.8.3.2) is below a certain value λ_{lim}.

Note: The value of λ_{lim} for use in a Country may be found in its National Annex. The recommended value follows from:

$$\lambda_{lim} = 20 \cdot A \cdot B \cdot C / \sqrt{n} \qquad (5.13N)$$

where:

A $= 1 / (1+0{,}2\varphi_{ef})$ (if φ_{ef} is not known, $A = 0{,}7$ may be used)

B $= \sqrt{1+2\omega}$ (if ω is not known, $B = 1{,}1$ may be used)

C $= 1{,}7 - r_m$ (if r_m is not known, $C = 0{,}7$ may be used)

φ_{ef} effective creep ratio; see 5.8.4;

ω $= A_s f_{yd} / (A_c f_{cd})$; mechanical reinforcement ratio;

A_s is the total area of longitudinal reinforcement

n $= N_{Ed} / (A_c f_{cd})$; relative normal force

r_m $= M_{01}/M_{02}$; moment ratio

M_{01}, M_{02} are the first order end moments, $|M_{02}| \geq |M_{01}|$

If the end moments M_{01} and M_{02} give tension on the same side, r_m should be taken positive (i.e. $C \leq 1{,}7$), otherwise negative (i.e. $C > 1{,}7$).

In the following cases, r_m should be taken as 1,0 (i.e. $C = 0{,}7$):
- for braced members in which the first order moments arise only from or predominantly due to imperfections or transverse loading
- for unbraced members in general

(2) In cases with biaxial bending, the slenderness criterion may be checked separately for each direction. Depending on the outcome of this check, second order effects (a) may be ignored in both directions, (b) should be taken into account in one direction, or (c) should be taken into account in both directions.

5.8.3.2 Slenderness and effective length of isolated members

(1) The slenderness ratio is defined as follows:

$$\lambda = l_0 / i \tag{5.14}$$

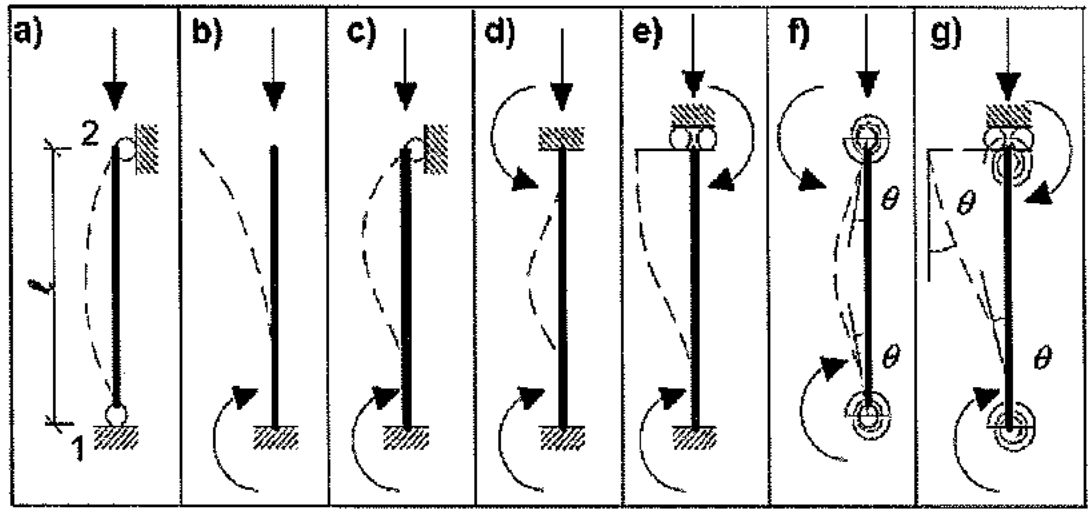
where:

l_0 is the effective length, see 5.8.3.2 (2) to (7)

i is the radius of gyration of the uncracked concrete section

(2) For a general definition of the effective length, see 5.8.1. Examples of effective length for isolated members with constant cross section are given in Figure 5.7.

AC2



a) $l_0 = l$ b) $l_0 = 2l$ c) $l_0 = 0{,}7l$ d) $l_0 = l/2$ e) $l_0 = l$ f) $l/2 < l_0 < l$ g) $l_0 > 2l$

AC2

Figure 5.7: Examples of different buckling modes and corresponding effective lengths for isolated members

(3) For compression members in regular frames, the slenderness criterion (see 5.8.3.1) should be checked with an effective length l_0 determined in the following way:

Braced members (see Figure 5.7 (f)):

$$l_0 = 0{,}5l \cdot \sqrt{\left(1 + \frac{k_1}{0{,}45 + k_1}\right) \cdot \left(1 + \frac{k_2}{0{,}45 + k_2}\right)} \tag{5.15}$$

Unbraced members (see Figure 5.7 (g)):

$$l_0 = l \cdot \max\left\{ \sqrt{1 + 10 \cdot \frac{k_1 \cdot k_2}{k_1 + k_2}} \; ; \left(1 + \frac{k_1}{1 + k_1}\right) \cdot \left(1 + \frac{k_2}{1 + k_2}\right) \right\} \tag{5.16}$$

where:

k_1, k_2 are the relative flexibilities of rotational restraints at ends 1 and 2 respectively:

Note. The value π^2 corresponds to a sinusoidal curvature distribution. The value for constant curvature is 8. Note that c depends on the distribution of the *total* curvature, whereas c_0 in 5.8.7.3 (2) depends on the curvature corresponding to the first order moment only.

5.8.8.3 Curvature

(1) For members with constant symmetrical cross sections (incl. reinforcement), the following may be used:

$$1/r = K_r \cdot K_\varphi \cdot 1/r_0 \tag{5.34}$$

where:

K_r is a correction factor depending on axial load, see 5.8.8.3 (3)

K_φ is a factor for taking account of creep, see 5.8.8.3 (4)

$1/r_0 = \varepsilon_{yd} / (0{,}45\, d)$

$\varepsilon_{yd} = f_{yd} / E_s$

d is the effective depth; see also 5.8.8.3 (2)

(2) If all reinforcement is not concentrated on opposite sides, but part of it is distributed parallel to the plane of bending, d is defined as

$$d = (h/2) + i_s \tag{5.35}$$

where i_s is the radius of gyration of the total reinforcement area

(3) K_r in Expression (5.34) should be taken as:

$$K_r = (n_u - n) / (n_u - n_{bal}) \leq 1 \tag{5.36}$$

where:

n $= N_{Ed} / (A_c\, f_{cd})$, relative axial force

N_{Ed} is the design value of axial force

n_u $= 1 + \omega$

n_{bal} is the value of n at maximum moment resistance; the value 0,4 may be used

ω $= A_s\, f_{yd} / (A_c\, f_{cd})$

A_s is the total area of reinforcement

A_c is the area of concrete cross section

(4) The effect of creep should be taken into account by the following factor:

$$K_\varphi = 1 + \beta \varphi_{ef} \geq 1 \tag{5.37}$$

where:

φ_{ef} is the effective creep ratio, see 5.8.4

β $= 0{,}35 + f_{ck}/200 - \lambda/150$

[AC2] λ is the slenderness ratio, see 5.8.3.2 [AC2]

5.8.9 Biaxial bending

(1) The general method described in 5.8.6 may also be used for biaxial bending. The following provisions apply when simplified methods are used. Special care should be taken to identify the section along the member with the critical combination of moments.

(2) Separate design in each principal direction, disregarding biaxial bending, may be made as a first step. Imperfections need to be taken into account only in the direction where they will have the most unfavourable effect.

(3) No further check is necessary if the slenderness ratios satisfy the following two conditions

$$\lambda_y/\lambda_z \le 2 \quad \text{and} \quad \lambda_z/\lambda_y \le 2 \tag{5.38a}$$

[AC1] and if the relative eccentricities e_y/h_{eq} and e_z/b_{eq} (see Figure 5.8) satisfy one the following [AC1] conditions:

$$\frac{e_y/h_{eq}}{e_z/b_{eq}} \le 0{,}2 \quad \text{or} \quad \frac{e_z/b_{eq}}{e_y/h_{eq}} \le 0{,}2 \tag{5.38b}$$

where:

b, h are the width and depth of the section

$b_{eq} = i_y \cdot \sqrt{12}$ and $h_{eq} = i_z \cdot \sqrt{12}$ for an equivalent rectangular section

λ_y, λ_z are the slenderness ratios l_0/i with respect to y- and z-axis respectively

i_y, i_z are the radii of gyration with respect to y- and z-axis respectively

e_z = M_{Edy} / N_{Ed}; eccentricity along z-axis

e_y = M_{Edz} / N_{Ed}; eccentricity along y-axis

M_{Edy} is the design moment about y-axis, including second order moment

M_{Edz} is the design moment about z-axis, including second order moment

N_{Ed} is the design value of axial load in the respective load combination

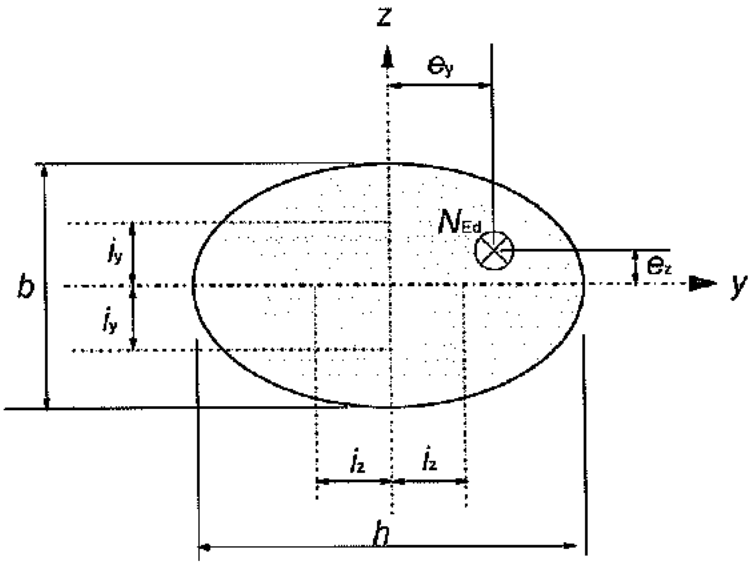


Figure 5.8. Definition of eccentricities e_y and e_z.

(4) If the condition of Expression (5.38) is not fulfilled, biaxial bending should be taken into account including the 2nd order effects in each direction (unless they may be ignored according to 5.8.2 (6) or 5.8.3). In the absence of an accurate cross section design for biaxial bending, the following simplified criterion may be used:

$$\left(\frac{M_{Edz}}{M_{Rdz}}\right)^a + \left(\frac{M_{Edy}}{M_{Rdy}}\right)^a \le 1{,}0 \tag{5.39}$$

where:

$M_{Edz/y}$ is the design moment around the respective axis, including a 2nd order moment.

$M_{Rdz/y}$ is the moment resistance in the respective direction

a is the exponent;

for circular and elliptical cross sections: $a = 2$

for rectangular cross sections:

N_{Ed}/N_{Rd}	0,1	0,7	1,0
a =	1,0	1,5	2,0

with linear interpolation for intermediate values

N_{Ed} is the design value of axial force

N_{Rd} = $A_c f_{cd} + A_s f_{yd}$, design axial resistance of section.

where:

A_c is the gross area of the concrete section

A_s is the area of longitudinal reinforcement

5.9 Lateral instability of slender beams

(1)P Lateral instability of slender beams shall be taken into account where necessary, e.g. for precast beams during transport and erection, for beams without sufficient lateral bracing in the finished structure etc. Geometric imperfections shall be taken into account.

(2) A lateral deflection of l / 300 should be assumed as a geometric imperfection in the verification of beams in unbraced conditions, with l = total length of beam. In finished structures, bracing from connected members may be taken into account

(3) Second order effects in connection with lateral instability may be ignored if the following conditions are fulfilled:

- persistent situations: $\frac{l_{0t}}{b} \le \frac{50}{(h/b)^{1/3}}$ and $h/b \le 2,5$ (5.40a)

- transient situations: $\frac{l_{0t}}{b} \le \frac{70}{(h/b)^{1/3}}$ and $h/b \le 3,5$ (5.40b)

where:

l_{0t} is the distance between torsional restraints

h is the total depth of beam in central part of l_{0t}

b is the width of compression flange

(4) Torsion associated with lateral instability should be taken into account in the design of supporting structures.

5.10 Prestressed members and structures

5.10.1 General

(1)P The prestress considered in this Standard is that applied to the concrete by stressed tendons.

(2) The effects of prestressing may be considered as an action or a resistance caused by prestrain and precurvature. The bearing capacity should be calculated accordingly.

(2) The shear resistance of a member with shear reinforcement is equal to:

$$V_{Rd} = V_{Rd,s} + V_{ccd} + V_{td} \quad (6.1)$$

(3) In regions of the member where $V_{Ed} \leq V_{Rd,c}$ no calculated shear reinforcement is necessary. V_{Ed} is the design shear force in the section considered resulting from external loading and prestressing (bonded or unbonded).

(4) When, on the basis of the design shear calculation, no shear reinforcement is required, minimum shear reinforcement should nevertheless be provided according to 9.2.2. The minimum shear reinforcement may be omitted in members such as slabs (solid, ribbed or hollow core slabs) where transverse redistribution of loads is possible. Minimum reinforcement may also be omitted in members of minor importance (e.g. lintels with span ≤ 2 m) which do not contribute significantly to the overall resistance and stability of the structure.

(5) In regions where $V_{Ed} > V_{Rd,c}$ according to Expression (6.2), sufficient shear reinforcement [AC1] should be provided in order that $V_{Ed} \leq V_{Rd}$ (see Expression (6.1)).[AC1]

(6) The sum of the design shear force and the contributions of the flanges, $V_{Ed} - V_{ccd} - V_{td}$, should not exceed the permitted maximum value $V_{Rd,max}$ (see 6.2.3), anywhere in the member.

(7) The longitudinal tension reinforcement should be able to resist the additional tensile force caused by shear (see 6.2.3 (7)).

(8) For members subject to predominantly uniformly distributed loading the design shear force need not to be checked at a distance less than d from the face of the support. Any shear reinforcement required should continue to the support. In addition it should be verified that the shear at the support does not exceed $V_{Rd,max}$ (see also 6.2.2 (6) and 6.2.3 (8).

(9) Where a load is applied near the bottom of a section, sufficient vertical reinforcement to carry the load to the top of the section should be provided in addition to any reinforcement required to resist shear.

6.2.2 Members not requiring design shear reinforcement

(1) The design value for the shear resistance $V_{Rd,c}$ is given by:

$$V_{Rd,c} = [C_{Rd,c} k (100\, \rho_l f_{ck})^{1/3} + k_1\, \sigma_{cp}]\, b_w d \quad (6.2.a)$$

with a minimum of

$$V_{Rd,c} = (v_{min} + k_1 \sigma_{cp})\, b_w d \quad (6.2.b)$$

where:

f_{ck} is in MPa

$k \quad = 1 + \sqrt{\frac{200}{d}} \leq 2{,}0$ with d in mm

$\rho_l \quad = \frac{A_{sl}}{b_w d} \leq 0{,}02$

A_{sl} is the area of the tensile reinforcement, which extends ≥ (l_{bd} + d) beyond the section considered (see Figure 6.3).

b_w is the smallest width of the cross-section in the tensile area [mm]
σ_{cp} = N_{Ed}/A_c < 0,2 f_{cd} [MPa]
N_{Ed} is the axial force in the cross-section due to loading or prestressing [in N] (N_{Ed}>0 AC1 for compression). The influence of imposed deformations on N_{Ed} may be ignored. AC1
A_C is the area of concrete cross section [mm^2]
$V_{Rd,c}$ is [N]

Note: The values of $C_{Rd,c}$, v_{min} and k_1 for use in a Country may be found in its National Annex. The recommended value for $C_{Rd,c}$ is 0,18/γ_c, that for v_{min} is given by Expression (6.3N) and that for k_1 is 0,15.

$$v_{min} = 0{,}035\, k^{3/2} \cdot f_{ck}^{1/2} \qquad (6.3N)$$

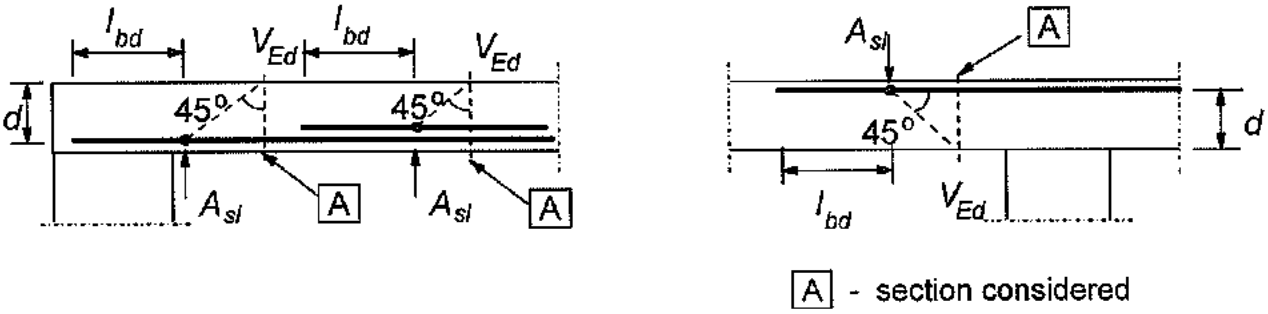


Figure 6.3: Definition of A_{sl} in Expression (6.2)

(2) In prestressed single span members without shear reinforcement, the shear resistance of the regions cracked in bending may be calculated using Expression (6.2a). In regions uncracked in bending (where the flexural tensile stress is smaller than $f_{ctk,0,05}/\gamma_c$) the shear resistance should be limited by the tensile strength of the concrete. In these regions the shear resistance is given by:

$$V_{Rd,c} = \frac{I \cdot b_w}{S} \sqrt{(f_{ctd})^2 + \alpha_l \sigma_{cp} f_{ctd}} \qquad (6.4)$$

where

I is the second moment of area
b_w is the width of the cross-section at the centroidal axis, allowing for the presence of ducts in accordance with Expressions (6.16) and (6.17)
S is the first moment of area above and about the centroidal axis
α_l = $l_x/l_{pt2} \leq 1{,}0$ for pretensioned tendons
= 1,0 for other types of prestressing
l_x is the distance of section considered from the starting point of the transmission length
l_{pt2} is the upper bound value of the transmission length of the prestressing element according to Expression (8.18).
σ_{cp} is the concrete compressive stress at the centroidal axis due to axial loading and/or prestressing (σ_{cp} = N_{Ed}/A_c in MPa, N_{Ed} > 0 in compression)

For cross-sections where the width varies over the height, the maximum principal stress may occur on an axis other than the centroidal axis. In such a case the minimum value of the shear resistance should be found by calculating $V_{Rd,c}$ at various axes in the cross-section.

(3) The calculation of the shear resistance according to Expression (6.4) is not required for cross-sections that are nearer to the support than the point which is the intersection of the elastic centroidal axis and a line inclined from the inner edge of the support at an angle of 45°.

(4) For the general case of members subjected to a bending moment and an axial force, which can be shown to be uncracked in flexure at the ULS, reference is made to 12.6.3.

(5) For the design of the longitudinal reinforcement, in the region cracked in flexure, the M_{Ed} - line should be shifted over a distance $a_l = d$ in the unfavourable direction (see 9.2.1.3 (2)).

(6) For members with loads applied on the upper side within a distance $0{,}5d \le a_v \le 2d$ from the edge of a support (or centre of bearing where flexible bearings are used), the contribution of this load to the shear force V_{Ed} may be multiplied by $\beta = a_v/2d$. This reduction may be applied for checking $V_{Rd,c}$ in Expression (6.2.a). This is only valid provided that the longitudinal reinforcement is fully anchored at the support. For $a_v \le 0{,}5d$ the value $a_v = 0{,}5d$ should be used.

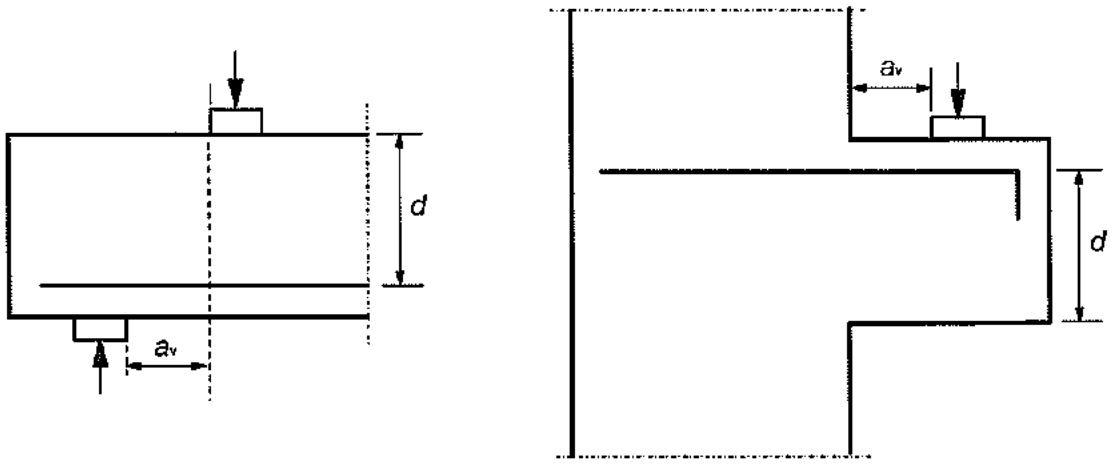
The shear force V_{Ed}, calculated without reduction by β, should however always satisfy the condition

$$V_{Ed} \le 0{,}5\, b_w d\, \nu f_{cd} \qquad (6.5)$$

where ν is a strength reduction factor for concrete cracked in shear

Note: The value ν for use in a Country may be found in its National Annex. The recommended value follows from:

$$\nu = 0{,}6\left[1 - \frac{f_{ck}}{250}\right] \quad (f_{ck} \text{ in MPa}) \qquad (6.6N)$$



(a) Beam with direct support **(b) Corbel**

Figure 6.4: Loads near supports

(7) Beams with loads near to supports and corbels may alternatively be designed with strut and tie models. For this alternative, reference is made to 6.5.

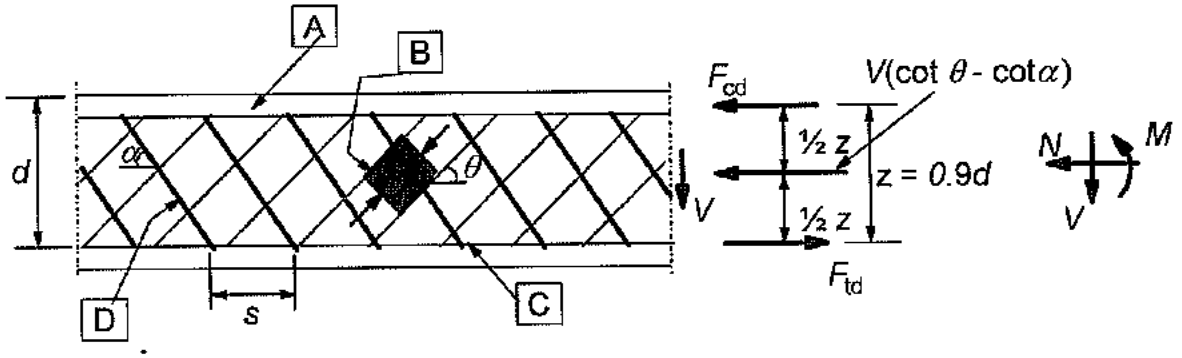
6.2.3 Members requiring design shear reinforcement

(1) The design of members with shear reinforcement is based on a truss model (Figure 6.5). Limiting values for the angle θ of the inclined struts in the web are given in 6.2.3 (2).

In Figure 6.5 the following notations are shown:

- α is the angle between shear reinforcement and the beam axis perpendicular to the shear force (measured positive as shown in Figure 6.5)
- θ is the angle between the concrete compression strut and the beam axis perpendicular to the shear force
- F_{td} is the design value of the tensile force in the longitudinal reinforcement
- F_{cd} is the design value of the concrete compression force in the direction of the longitudinal member axis.
- b_w is the minimum width between tension and compression chords
- z is the inner lever arm, for a member with constant depth, corresponding to the bending moment in the element under consideration. In the shear analysis of reinforced concrete without axial force, the approximate value $z = 0{,}9d$ may normally be used.

In elements with inclined prestressing tendons, longitudinal reinforcement at the tensile chord [AC1] should be provided to carry the longitudinal tensile force due to shear defined in (7).[AC1]



A - compression chord, B - struts, C - tensile chord, D - shear reinforcement

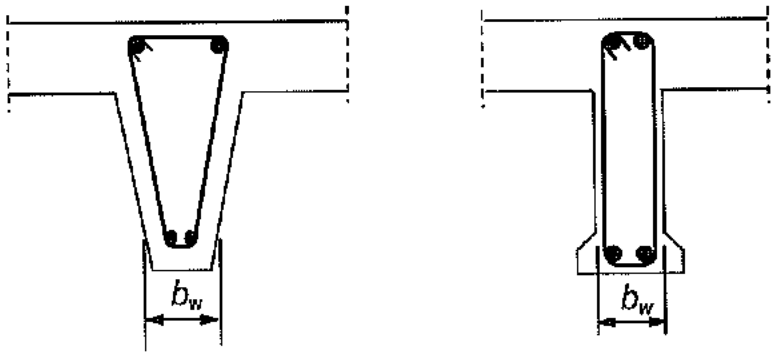


Figure 6.5: Truss model and notation for shear reinforced members

(2) The angle θ should be limited.

Note: The limiting values of $\cot\theta$ for use in a Country may be found in its National Annex. The recommended limits are given in Expression (6.7N).

$$1 \leq \cot\theta \leq 2{,}5 \qquad (6.7N)$$

(3) For members with vertical shear reinforcement, the shear resistance, V_{Rd} is the smaller value of:

$$V_{Rd,s} = \frac{A_{sw}}{s} z f_{ywd} \cot\theta \quad (6.8)$$

Note: If Expression (6.10) is used the value of f_{ywd} should be reduced to 0,8 f_{ywk} in Expression (6.8)

and

$$V_{Rd,max} = \alpha_{cw} b_w z \nu_1 f_{cd}/(\cot\theta + \tan\theta) \quad (6.9)$$

where:

A_{sw} is the cross-sectional area of the shear reinforcement
s is the spacing of the stirrups
f_{ywd} is the design yield strength of the shear reinforcement
ν_1 is a strength reduction factor for concrete cracked in shear
α_{cw} is a coefficient taking account of the state of the stress in the compression chord

Note 1: The value of ν_1 and α_{cw} for use in a Country may be found in its National Annex. The recommended value of ν_1 is ν (see Expression (6.6N)).

Note 2: If the design stress of the shear reinforcement is below 80% of the characteristic yield stress f_{yk}, ν_1 may be taken as:

$\nu_1 = 0,6$ for $f_{ck} \le 60$ MPa (6.10.aN)
$\nu_1 = 0,9 - f_{ck}/200 > 0,5$ for $f_{ck} \ge 60$ MPa (6.10.bN)

Note 3: The recommended value of α_{cw} is as follows:

1 for non-prestressed structures
$(1 + \sigma_{cp}/f_{cd})$ for $0 < \sigma_{cp} \le 0,25\ f_{cd}$ (6.11.aN)
1,25 for $0,25\ f_{cd} < \sigma_{cp} \le 0,5\ f_{cd}$ (6.11.bN)
$2,5\ (1 - \sigma_{cp}/f_{cd})$ for $0,5\ f_{cd} < \sigma_{cp} < 1,0\ f_{cd}$ (6.11.cN)

where:

σ_{cp} is the mean compressive stress, measured positive, in the concrete due to the design axial force. This should be obtained by averaging it over the concrete section taking account of the reinforcement. The value of σ_{cp} need not be calculated at a distance less than $0.5d \cot\theta$ from the edge of the support.

Note 4: The maximum effective cross-sectional area of the shear reinforcement, $A_{sw,max}$, for $\cot\theta = 1$ is given by:

$$\frac{A_{sw,max} f_{ywd}}{b_w s} \le \tfrac{1}{2}\ \alpha_{cw} \nu_1 f_{cd} \quad (6.12)$$

(4) For members with inclined shear reinforcement, the shear resistance is the smaller value of

$$V_{Rd,s} = \frac{A_{sw}}{s} z f_{ywd} (\cot\theta + \cot\alpha)\sin\alpha \quad (6.13)$$

and

$$V_{Rd,max} = \alpha_{cw} b_w z \nu_1 f_{cd} (\cot\theta + \cot\alpha)/(1 + \cot^2\theta) \quad (6.14)$$

Note: The maximum effective shear reinforcement, $A_{sw,max}$ for $\cot\theta = 1$ follows from:

$$\frac{A_{sw,max}\ f_{ywd}}{b_w s} \le \frac{\frac{1}{2}\alpha_{cw} \nu_1 f_{cd}}{\sin\alpha} \quad (6.15)$$

(5) In regions where there is no discontinuity of V_{Ed} (AC1) (e.g. for uniformly distributed loading applied at the top) the shear reinforcement in any length increment $l = z(\cot\theta)$ may be (AC1) calculated using the smallest value of V_{Ed} in the increment.

(6) (AC1) Where the web contains grouted metal ducts (AC1) with a diameter $\phi > b_w/8$ the shear resistance $V_{Rd,max}$ should be calculated on the basis of a nominal web thickness given by:

$$b_{w,nom} = b_w - 0{,}5\Sigma\phi \tag{6.16}$$

where ϕ is the outer diameter of the duct and $\Sigma\phi$ is determined for the most unfavourable level.

For grouted metal ducts with $\phi \leq b_w/8$, $b_{w,nom} = b_w$

For non-grouted ducts, grouted plastic ducts and unbonded tendons the nominal web thickness is:

$$b_{w,nom} = b_w - 1{,}2\,\Sigma\phi \tag{6.17}$$

The value 1,2 in Expression (6.17) is introduced to take account of splitting of the concrete struts due to transverse tension. If adequate transverse reinforcement is provided this value may be reduced to 1,0.

(7) The additional tensile force, ΔF_{td}, in the longitudinal reinforcement due to shear V_{Ed} may be calculated from:

$$\Delta F_{td} = 0{,}5\,V_{Ed}\,(\cot\theta - \cot\alpha) \tag{6.18}$$

$(M_{Ed}/z) + \Delta F_{td}$ should be taken not greater than $M_{Ed,max}/z$, where $M_{Ed,max}$ is the maximum moment along the beam.

(8) For members with loads applied on the upper side within a distance $0{,}5d \leq a_v \leq 2{,}0d$ the contribution of this load to the shear force V_{Ed} may be reduced by $\beta = a_v/2d$.
The shear force V_{Ed}, calculated in this way, should satisfy the condition

$$V_{Ed} \leq A_{sw} f_{ywd} \sin\alpha \tag{6.19}$$

where $A_{sw} f_{ywd}$ is the resistance of the shear reinforcement crossing the inclined shear crack between the loaded areas (see Figure 6.6). Only the shear reinforcement within the central $0{,}75\,a_v$ should be taken into account. The reduction by β should only be applied for calculating the shear reinforcement. It is only valid provided that the longitudinal reinforcement is fully anchored at the support.

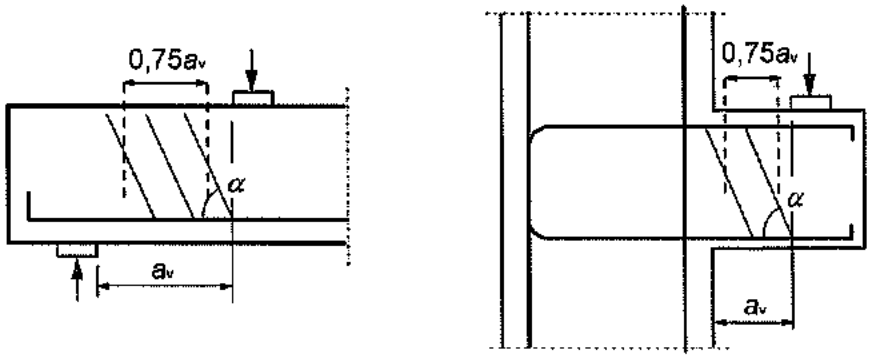


Figure 6.6: Shear reinforcement in short shear spans with direct strut action

For $a_v < 0{,}5d$ the value $a_v = 0{,}5d$ should be used.

(AC1) The value V_{Ed} calculated without reduction by β, should however always be less than $V_{Rd,max}$, see Expression (6.9).(AC1)

(AC1) 6.2.4 Shear between web and flanges (AC1)

(1) The shear strength of the flange may be calculated by considering the flange as a system of compressive struts combined with ties in the form of tensile reinforcement.

(2) A minimum amount of longitudinal reinforcement should be provided, as specified in 9.3.1.

(3) The longitudinal shear stress, v_{Ed}, at the junction between one side of a flange and the web is determined by the change of the normal (longitudinal) force in the part of the flange considered, according to:

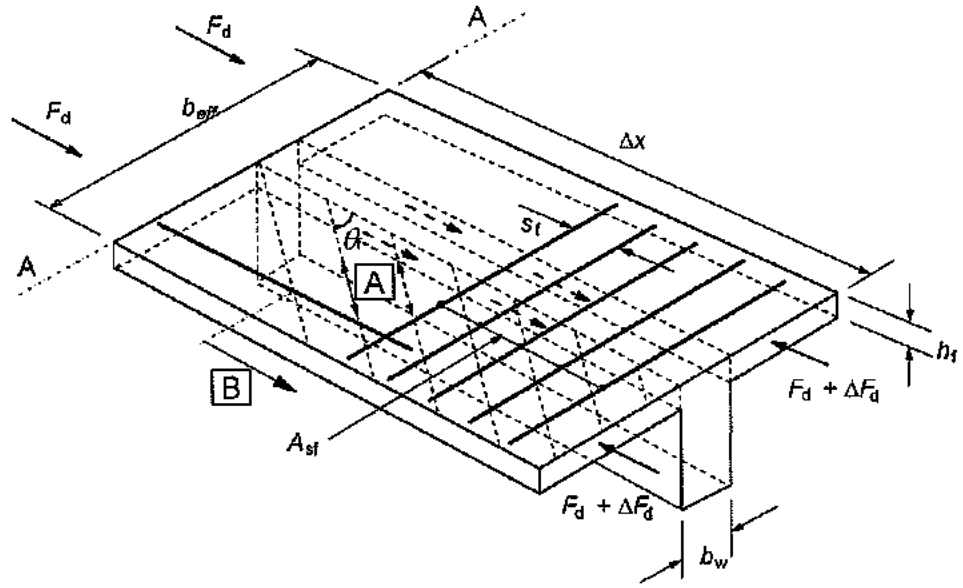
$$v_{Ed} = \Delta F_d/(h_f \cdot \Delta x) \qquad (6.20)$$

where:

h_f is the thickness of flange at the junctions

Δx is the length under consideration, see Figure 6.7

ΔF_d is the change of the normal force in the flange over the length Δx.



A - compressive struts B - longitudinal bar anchored beyond this projected point (see 6.2.4 (7))

Figure 6.7: Notations for the connection between flange and web

The maximum value that may be assumed for Δx is half the distance between the section where the moment is 0 and the section where the moment is maximum. Where point loads are applied the length Δx should not exceed the distance between point loads.

(4) The transverse reinforcement per unit length A_{sf}/s_f may be determined as follows:

$$(A_{sf}f_{yd}/s_f) \geq v_{Ed} \cdot h_f / \cot \theta_f \qquad (6.21)$$

To prevent crushing of the compression struts in the flange, the following condition should be satisfied:

$$v_{Ed} \leq \nu f_{cd} \sin\theta_f \cos\theta_f \quad (6.22)$$

Note: The permitted range of the values for cot θ_f for use in a country may be found in its National Annex. The recommended values in the absence of more rigorous calculation are:

$1,0 \leq \cot\theta_f \leq 2,0$ for compression flanges ($45° \geq \theta_f \geq 26,5°$)

$1,0 \leq \cot\theta_f \leq 1,25$ for tension flanges ($45° \geq \theta_f \geq 38,6°$)

(5) In the case of combined shear between the flange and the web, and transverse bending, the area of steel should be the greater than that given by Expression (6.21) or half that given by Expression (6.21) plus that required for transverse bending.

(6) If v_{Ed} is less than or equal to kf_{ctd} no extra reinforcement above that for flexure is required.

Note: The value of k for use in a Country may be found in its National Annex. The recommended value is 0,4.

(7) Longitudinal tension reinforcement in the flange should be anchored beyond the strut required to transmit the force back to the web at the section where this reinforcement is required (See Section (A - A) of Figure 6.7).

6.2.5 Shear at the interface between concrete cast at different times

(1) In addition to the requirements of 6.2.1- 6.2.4 the shear stress at the interface between concrete cast at different times should also satisfy the following:

$$v_{Edi} \leq v_{Rdi} \quad (6.23)$$

v_{Edi} is the design value of the shear stress in the interface and is given by:

$$v_{Edi} = \beta V_{Ed} / (z\, b_i) \quad (6.24)$$

where:

- β is the ratio of the longitudinal force in the new concrete area and the total longitudinal force either in the compression or tension zone, both calculated for the section considered
- V_{Ed} is the transverse shear force
- z is the lever arm of composite section
- b_i is the width of the interface (see Figure 6.8)
- v_{Rdi} is the design shear resistance at the interface and is given by:

$$v_{Rdi} = c\, f_{ctd} + \mu\, \sigma_n + \rho\, f_{yd} (\mu \sin\alpha + \cos\alpha) \leq 0,5\, \nu\, f_{cd} \quad (6.25)$$

where:

- c and μ are factors which depend on the roughness of the interface (see (2))
- f_{ctd} is as defined in 3.1.6 (2)P
- σ_n stress per unit area caused by the minimum external normal force across the interface that can act simultaneously with the shear force, positive for compression, such that $\sigma_n < 0,6\, f_{cd}$, and negative for tension. When σ_n is tensile $c\, f_{ctd}$ should be taken as 0.
- ρ $= A_s / A_i$

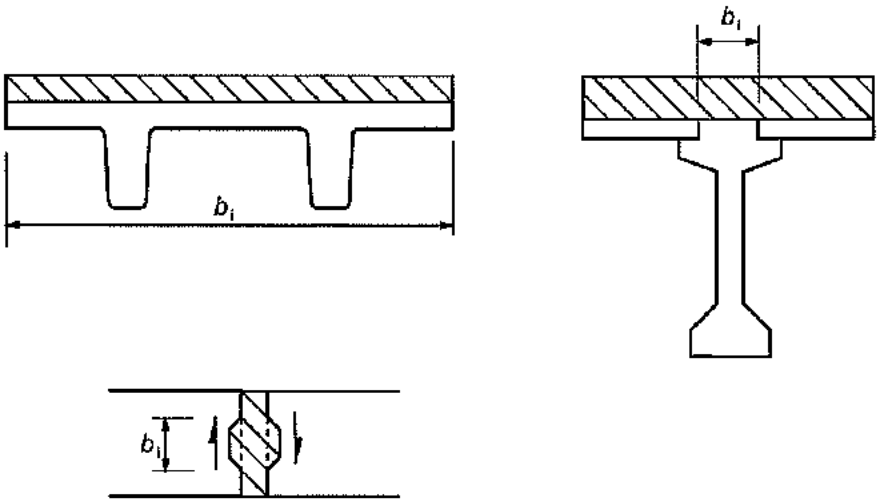


Figure 6.8: Examples of interfaces

A_s is the area of reinforcement crossing the interface, including ordinary shear reinforcement (if any), with adequate anchorage at both sides of the interface.
A_i is the area of the joint
α is defined in Figure 6.9, and should be limited by $45° \leq \alpha \leq 90°$
ν is a strength reduction factor (see 6.2.2 (6))

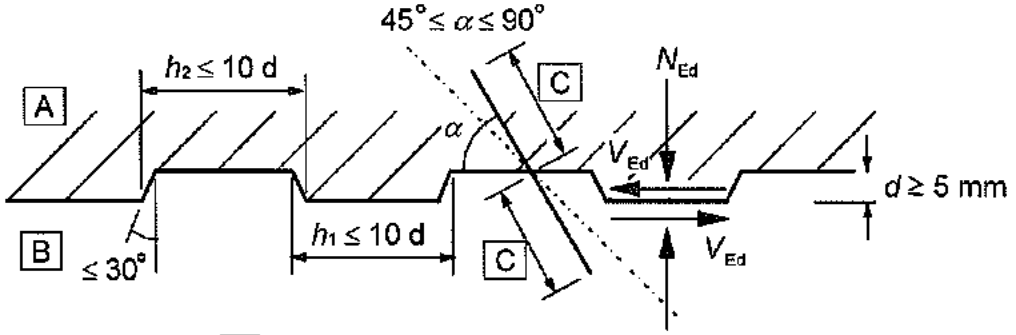


Figure 6.9: Indented construction joint

(2) In the absence of more detailed information surfaces may be classified as very smooth, smooth, rough or indented, with the following examples:

- Very smooth: a surface cast against steel, plastic or specially prepared wooden moulds: $c = 0{,}025$ to $0{,}10$ and $\mu = 0{,}5$
- Smooth: a slipformed or extruded surface, or a free surface left without further treatment after vibration: $c = 0{,}20$ and $\mu = 0{,}6$
- Rough: a surface with at least 3 mm roughness at about 40 mm spacing, achieved by raking, exposing of aggregate or other methods giving an equivalent behaviour: $c = 0{,}40$ and $\mu = 0{,}7$
- Indented: a surface with indentations complying with Figure 6.9: $c = 0{,}50$ and $\mu = 0{,}9$

(3) A stepped distribution of the transverse reinforcement may be used, as indicated in Figure 6.10. Where the connection between the two different concretes is ensured by reinforcement

(3) The spacing of the transverse reinforcement along the column should not exceed $s_{cl,tmax}$

Note: The value of $s_{cl,tmax}$ for use in a Country may be found in its National Annex. The recommended value is the least of the following three distances:
- 20 times the minimum diameter of the longitudinal bars
- the lesser dimension of the column
- 400 mm

(4) The maximum spacing required in (3) should be reduced by a factor 0,6:

(i) in sections within a distance equal to the larger dimension of the column cross-section above or below a beam or slab;

(ii) near lapped joints, if the maximum diameter of the longitudinal bars is greater than 14 mm. A minimum of 3 bars evenly placed in the lap length is required.

(5) Where the direction of the longitudinal bars changes, (e.g. at changes in column size), the spacing of transverse reinforcement should be calculated, taking account of the lateral forces involved. These effects may be ignored if the change of direction is less than or equal to 1 in 12.

(6) Every longitudinal bar or bundle of bars placed in a corner should be held by transverse reinforcement. No bar within a compression zone should be further than 150 mm from a restrained bar.

9.6 Walls

9.6.1 General

(1) This clause refers to reinforced concrete walls with a length to thickness ratio of 4 or more and in which the reinforcement is taken into account in the strength analysis. The amount and proper detailing of reinforcement may be derived from a strut-and-tie model (see 6.5). For walls subjected predominantly to out-of-plane bending the rules for slabs apply (see 9.3).

9.6.2 Vertical reinforcement

(1) The area of the vertical reinforcement should lie between $A_{s,vmin}$ and $A_{s,vmax}$.

Note 1: The value of $A_{s,vmin}$ for use in a Country may be found in its National Annex. The recommended value is 0,002 A_c.

Note 2: The value of $A_{s,vmax}$ for use in a Country may be found in its National Annex. The recommended value is 0,04 A_c outside lap locations unless it can be shown that the concrete integrity is not affected and that the full strength is achieved at ULS. This limit may be doubled at laps.

(2) Where the minimum area of reinforcement, $A_{s,vmin}$, controls in design, half of this area should be located at each face.

(3) The distance between two adjacent vertical bars shall not exceed 3 times the wall thickness or 400 mm whichever is the lesser.

9.6.3 Horizontal reinforcement

(1) Horizontal reinforcement running parallel to the faces of the wall (and to the free edges) should be provided at each surface. It should not be less than $A_{s,hmin}$.

Note: The value of $A_{s,hmin}$ for use in a Country may be found in its National Annex. The recommended value is either 25% of the vertical reinforcement or 0,001 A_c, whichever is greater.

(3) Where two parts connected by welding are separated by packing having a thickness equal to, or greater than, the leg length of weld necessary to transmit the force, each of the parts should be connected to the packing by a weld capable of transmitting the design force.

4.5 Design resistance of a fillet weld

4.5.1 Length of welds

(1) The effective length of a fillet weld l should be taken as the length over which the fillet is full-size. This maybe taken as the overall length of the weld reduced by twice the effective throat thickness a. Provided that the weld is full size throughout its length including starts and terminations, no reduction in effective length need be made for either the start or the termination of the weld.

(2) A fillet weld with an effective length less than 30 mm or less than 6 times its throat thickness, whichever is larger, should not be designed to carry load.

4.5.2 Effective throat thickness

(1) The effective throat thickness, a, of a fillet weld should be taken as the height of the largest triangle (with equal or unequal legs) that can be inscribed within the fusion faces and the weld surface, measured perpendicular to the outer side of this triangle, see Figure 4.3.

(2) The effective throat thickness of a fillet weld should not be less than 3 mm.

(3) In determining the design resistance of a deep penetration fillet weld, account may be taken of its additional throat thickness, see Figure 4.4, provided that preliminary tests show that the required penetration can consistently be achieved.

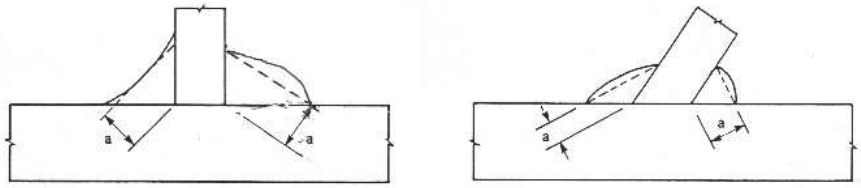


Figure 4.3: Throat thickness of a fillet weld

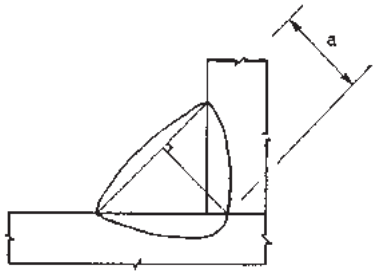


Figure 4.4: Throat thickness of a deep penetration fillet weld

4.5.3 Design Resistance of fillet welds

4.5.3.1 General

(1) The design resistance of a fillet weld should be determined using either the Directional method given in 4.5.3.2 or the Simplified method given in 4.5.3.3.

4.5.3.2 Directional method

(1) In this method, the forces transmitted by a unit length of weld are resolved into components parallel and transverse to the longitudinal axis of the weld and normal and transverse to the plane of its throat.

(2) The design throat area A_w should be taken as $A_w = \sum a\ \ell_{eff}$.

(3) The location of the design throat area should be assumed to be concentrated in the root.

(4) A uniform distribution of stress is assumed on the throat section of the weld, leading to the normal stresses and shear stresses shown in Figure 4.5, as follows:

- $\sigma_\perp$ is the normal stress perpendicular to the throat
- $\sigma_\parallel$ is the normal stress parallel to the axis of the weld
- $\tau_\perp$ is the shear stress (in the plane of the throat) perpendicular to the axis of the weld
- $\tau_\parallel$ is the shear stress (in the plane of the throat) parallel to the axis of the weld.

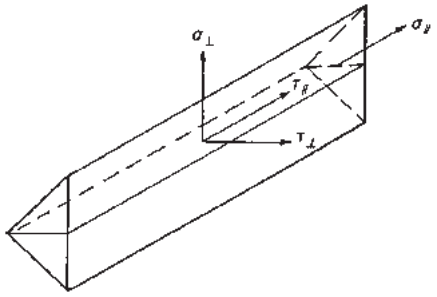


Figure 4.5: Stresses on the throat section of a fillet weld

(5) The normal stress $\sigma_\parallel$ parallel to the axis is not considered when verifying the design resistance of the weld.

(6) The design resistance of the fillet weld will be sufficient if the following are both satisfied:

$$[\sigma_\perp^2 + 3\,(\tau_\perp^2 + \tau_\parallel^2)]^{0,5} \le f_u / (\beta_w\,\gamma_{M2}) \quad \text{and} \quad \sigma_\perp \le 0.9\,f_u / \gamma_{M2} \qquad \text{... (4.1)}$$

where:

f_u is the nominal ultimate tensile strength of the weaker part joined;

β_w is the appropriate correlation factor taken from Table 4.1.

(7) Welds between parts with different material strength grades should be designed using the properties of the material with the lower strength grade.

Table 4.1: Correlation factor β_w for fillet welds

Standard and steel grade			Correlation factor β_w
EN 10025	**EN 10210**	**EN 10219**	
S 235 S 235 W	S 235 H	S 235 H	0,8
S 275 S 275 N/NL S 275 M/ML	S 275 H S 275 NH/NLH	S 275 H S 275 NH/NLH S 275 MH/MLH	0,85
S 355 S 355 N/NL S 355 M/ML S 355 W	S 355 H S 355 NH/NLH	S 355 H S 355 NH/NLH S 355 MH/MLH	0,9
S 420 N/NL S 420 M/ML		S 420 MH/MLH	1,0
S 460 N/NL S 460 M/ML S 460 Q/QL/QL1	S 460 NH/NLH	S 460 NH/NLH S 460 MH/MLH	1,0

4.5.3.3 Simplified method for design resistance of fillet weld

(1) Alternatively to 4.5.3.2 the design resistance of a fillet weld may be assumed to be adequate if, at every point along its length, the resultant of all the forces per unit length transmitted by the weld satisfy the following criterion:

$$F_{w,Ed} \leq F_{w,Rd} \quad \text{... (4.2)}$$

where:

$F_{w,Ed}$ is the design value of the weld force per unit length;

$F_{w,Rd}$ is the design weld resistance per unit length.

(2) Independent of the orientation of the weld throat plane to the applied force, the design resistance per unit length $F_{w,Rd}$ should be determined from:

$$F_{w,Rd} = f_{vw.d}\, a \quad \text{... (4.3)}$$

where:

$f_{vw.d}$ is the design shear strength of the weld.

(3) The design shear strength $f_{vw.d}$ of the weld should be determined from:

$$f_{vw.d} = \frac{f_u / \sqrt{3}}{\beta_w \gamma_{M2}} \quad \text{... (4.4)}$$

where:

f_u and β_w are defined in 4.5.3.2(6).

4.6 Design resistance of fillet welds all round

(1) The design resistance of a fillet weld all round should be determined using one of the methods given in 4.5.

4.7 Design resistance of butt welds

4.7.1 Full penetration butt welds

(1) The design resistance of a full penetration butt weld should be taken as equal to the design resistance of the weaker of the parts connected, provided that the weld is made with a suitable consumable which will produce all-weld tensile specimens having both a minimum yield strength and a minimum tensile strength not less than those specified for the parent metal.

4.7.2 Partial penetration butt welds

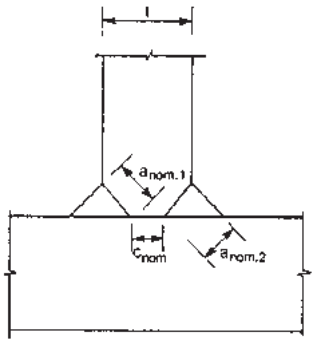
(1) The design resistance of a partial penetration butt weld should be determined using the method for a deep penetration fillet weld given in 4.5.2(3).

(2) The throat thickness of a partial penetration butt weld should not be greater than the depth of penetration that can be consistently achieved, see 4.5.2(3).

4.7.3 T-butt joints

(1) The design resistance of a T-butt joint, consisting of a pair of partial penetration butt welds reinforced by superimposed fillet welds, may be determined as for a full penetration butt weld (see 4.7.1) if the total nominal throat thickness, exclusive of the unwelded gap, is not less than the thickness t of the part forming the stem of the tee joint, provided that the unwelded gap is not more than (t / 5) or 3 mm, whichever is less, see Figure 4.6(a).

(2) The design resistance of a T-butt joint which does not meet the requirements given in 4.7.3(1) should be determined using the method for a fillet weld or a deep penetration fillet weld given in 4.5 depending on the amount of penetration. The throat thickness should be determined in conformity with the provisions for fillet welds (see 4.5.2) or partial penetration butt welds (see 4.7.2) as relevant.



$a_{nom,1} + a_{nom,2} \geq t$
c_{nom} should be the smaller of t/5 and 3 mm

Figure 4.6: Effective full penetration of T-butt welds

4.8 Design resistance of plug welds

(1) The design resistance $F_{w,Rd}$ of a plug weld (see 4.3.3) should be taken as:

$$F_{w,Rd} = f_{vw,d} A_w, \quad \text{... (4.5)}$$

where

$f_{vw.d}$ is the design shear strength of a weld given in 4.5.3.3(3);

A_w is the design throat area and should be taken as the area of the hole.

6 Ultimate limit states

6.1 General

(1) The partial factors γ_M as defined in 2.4.3 should be applied to the various characteristic values of resistance in this section as follows:

- resistance of cross-sections whatever the class is: γ_{M0}
- resistance of members to instability assessed by member checks: γ_{M1}
- resistance of cross-sections in tension to fracture: γ_{M2}
- resistance of joints: see EN 1993-1-8

NOTE 1 For other recommended numerical values see EN 1993 Part 2 to Part 6. For structures not covered by EN 1993 Part 2 to Part 6 the National Annex may define the partial factors γ_{Mi}; it is recommended to take the partial factors γ_{Mi} from EN 1993-2.

NOTE 2B Partial factors γ_{Mi} for buildings may be defined in the National Annex. The following numerical values are recommended for buildings:

$\gamma_{M0} = 1{,}00$

$\gamma_{M1} = 1{,}00$

$\gamma_{M2} = 1{,}25$

6.2 Resistance of cross-sections

6.2.1 General

[AC1] (1)P The design value of an action effect in each cross section shall not exceed the corresponding design resistance and if several action effects act simultaneously the combined effect shall not exceed the resistance for that combination. [AC1]

(2) Shear lag effects and local buckling effects should be included by an effective width according to EN 1993-1-5. Shear buckling effects should also be considered according to EN 1993-1-5.

(3) The design values of resistance should depend on the classification of the cross-section.

(4) Elastic verification according to the elastic resistance may be carried out for all cross sectional classes provided the effective cross sectional properties are used for the verification of class 4 cross sections.

(5) For the elastic verification the following yield criterion for a critical point of the cross section may be used unless other interaction formulae apply, see 6.2.8 to 6.2.10.

$$\left(\frac{\sigma_{x,Ed}}{f_y/\gamma_{M0}}\right)^2 + \left(\frac{\sigma_{z,Ed}}{f_y/\gamma_{M0}}\right)^2 - \left(\frac{\sigma_{x,Ed}}{f_y/\gamma_{M0}}\right)\left(\frac{\sigma_{z,Ed}}{f_y/\gamma_{M0}}\right) + 3\left(\frac{\tau_{Ed}}{f_y/\gamma_{M0}}\right)^2 \le 1 \qquad (6.1)$$

where $\sigma_{x,Ed}$ is the design value of the local longitudinal stress at the point of consideration

$\sigma_{z,Ed}$ is the design value of the local transverse stress at the point of consideration

τ_{Ed} is the design value of the local shear stress at the point of consideration

NOTE The verification according to (5) can be conservative as it excludes partial plastic stress distribution, which is permitted in elastic design. Therefore it should only be performed where the interaction of on the basis of resistances N_{Rd} , M_{Rd} , V_{Rd} cannot be performed.

6.2.5 Bending moment

[AC1] (1)P The design value of the bending moment M_{Ed} at each cross-section shall satisfy: [AC1]

$$\frac{M_{Ed}}{M_{c,Rd}} \leq 1{,}0 \tag{6.12}$$

where $M_{c,Rd}$ is determined considering fastener holes, see (4) to (6).

(2) The design resistance for bending about one principal axis of a cross-section is determined as follows:

$$M_{c,Rd} = M_{pl,Rd} = \frac{W_{pl}\, f_y}{\gamma_{M0}} \qquad \text{for class 1 or 2 cross sections} \tag{6.13}$$

$$M_{c,Rd} = M_{el,Rd} = \frac{W_{el,min}\, f_y}{\gamma_{M0}} \qquad \text{for class 3 cross sections} \tag{6.14}$$

$$M_{c,Rd} = \frac{W_{eff,min}\, f_y}{\gamma_{M0}} \qquad \text{for class 4 cross sections} \tag{6.15}$$

where $W_{el,min}$ and $W_{eff,min}$ corresponds to the fibre with the maximum elastic stress.

(3) For bending about both axes, the methods given in 6.2.9 should be used.

(4) Fastener holes in the tension flange may be ignored provided that for the tension flange:

$$\frac{A_{f,net}\, 0{,}9\, f_u}{\gamma_{M2}} \geq \frac{A_f\, f_y}{\gamma_{M0}} \tag{6.16}$$

where A_f is the area of the tension flange.

NOTE The criterion in (4) provides capacity design (see 1.5.8) in the region of plastic hinges.

(5) Fastener holes in tension zone of the web need not be allowed for, provided that the limit given in (4) is satisfied for the complete tension zone comprising the tension flange plus the tension zone of the web.

(6) Fastener holes except for oversize and slotted holes in compression zone of the cross-section need not be allowed for, provided that they are filled by fasteners.

6.2.6 Shear

[AC1] (1)P The design value of the shear force V_{Ed} at each cross section shall satisfy: [AC1]

$$\frac{V_{Ed}}{V_{c,Rd}} \leq 1{,}0 \tag{6.17}$$

where $V_{c,Rd}$ is the design shear resistance. For plastic design $V_{c,Rd}$ is the design plastic shear resistance $V_{pl,Rd}$ as given in (2). For elastic design $V_{c,Rd}$ is the design elastic shear resistance calculated using (4) and (5).

(2) In the absence of torsion the design plastic shear resistance is given by:

$$V_{pl,Rd} = \frac{A_v \left(f_y / \sqrt{3}\right)}{\gamma_{M0}} \tag{6.18}$$

where A_v is the shear area.

(3) The shear area A_v may be taken as follows:

a) rolled I and H sections, load parallel to web $A - 2bt_f + (t_w + 2r)\,t_f$ but not less than $\eta h_w t_w$

b) rolled channel sections, load parallel to web $A - 2bt_f + (t_w + r)\,t_f$

c) rolled T-section, load parallel to web $0{,}9\,(A - bt_f)$

d) welded I, H and box sections, load parallel to web $\eta \sum (h_w t_w)$

e) welded I, H, channel and box sections, load parallel to flanges $A - \sum (h_w t_w)$

f) rolled rectangular hollow sections of uniform thickness:

load parallel to depth	Ah/(b+h)
load parallel to width	Ab/(b+h)

g) circular hollow sections and tubes of uniform thickness $2A/\pi$

where A is the crosssectional area;

b is the overall breadth;

h is the overall depth;

h_w is the depth of the web;

r is the root radius;

t_f is the flange thickness;

t_w is the web thickness (If the web thickness in not constant, t_w should be taken as the minimum thickness.).

η see EN 1993-1-5.

NOTE η may be conservatively taken equal 1,0.

(4) For verifying the design elastic shear resistance $V_{c,Rd}$ the following criterion for a critical point of the cross section may be used unless the buckling verification in section 5 of EN 1993-1-5 applies:

$$\frac{\tau_{Ed}}{f_y / \left(\sqrt{3}\,\gamma_{M0}\right)} \le 1{,}0 \qquad (6.19)$$

where τ_{Ed} may be obtained from: $\tau_{Ed} = \dfrac{V_{Ed}\,S}{I\,t}$ (6.20)

where V_{Ed} is the design value of the shear force

S is the first moment of area about the centroidal axis of that portion of the cross-section between the point at which the shear is required and the boundary of the cross-section

I is second moment of area of the whole cross section

t is the thickness at the examined point

NOTE The verification according to (4) is conservative as it excludes partial plastic shear distribution, which is permitted in elastic design, see (5). Therefore it should only be carried out where the verification on the basis of $V_{c,Rd}$ according to equation (6.17) cannot be performed.

EXAMPLE 5.4.2

Shear and Torsion Design of a Prestressed Concrete Component (cont.)

$$\frac{50b_w}{f_{yt}}\left[1+12\left(\frac{f_{pc}}{f_c'}\right)\right]=\frac{50(8)}{60{,}000}\left[1+12\left(\frac{0.088}{6}\right)\right]=0.008$$

Use 0.028 in Eq. 5-43:

$$A_\ell = \left[\frac{400x}{f_y}\left[\frac{T_u}{T_u+\frac{V_u}{3C_t}}\right]-\frac{2A_t}{s}\right](x_1+y_1)=\left[\frac{400(8)}{60{,}000}\left[\frac{721}{721+\frac{83.4}{3(0.091)}}\right]-0.028\right](5.5+72.5)=0.738 \text{ in.}^2$$

Use A_ℓ = 2.18 in.^{2} distributed around perimeter. The maximum spacing is 12 in. Prestressing strands not required for flexure can also be counted. Thus, additional #4 @ 12 in. is adequate.

The transverse and longitudinal reinforcement can be reduced to the interior span side of the first double-tee stem.

5.5 Beams with Ledges

As shown in the previous example, one of the most common occurrences of torsion in precast concrete components is in L-shaped beams (beams with a ledge on one side). Significant torsion may also occur in inverted-tee beams with severely unbalanced loads. This section covers additional design items related to the beam end and the ledge and its attachment to the web. These items are discussed in References 13 through 16 and are shown in Fig. 5.5.1.

5.5.1 Shear Strength of Ledge

The design shear strength of continuous beam ledges supporting concentrated loads can be determined by the lesser of Eq. 5-44 and 5-45:

for $s > b_t + h_\ell$

$$\phi V_n = 3\phi\lambda\sqrt{f_c'}h_\ell\left[2\left(b_\ell-b\right)+b_t+h_\ell\right] \quad \text{(Eq. 5-44)}$$

$$\phi V_n = \phi\lambda\sqrt{f_c'}h_\ell\left[2\left(b_\ell-b\right)+b_t+h_\ell+2d_e\right] \quad \text{(Eq. 5-45)}$$

For $s < b_t + h_\ell$ and equal concentrated loads, use the lesser of Eq. 5-46, 5-47, or 5-48.

$$\phi V_n = 1.5\phi\lambda\sqrt{f_c'}h_\ell\left[2\left(b_\ell-b\right)+b_t+h_\ell+s\right] \quad \text{(Eq. 5-46)}$$

$$\phi V_n = \phi\lambda\sqrt{f_c'}h_\ell\left[\left(b_\ell-b\right)+\left(\frac{b_t+h_\ell}{2}\right)+d_e+s\right] \quad \text{(Eq. 5-47)}$$

where:

ϕ = 0.75
h_ℓ = depth of beam ledge, in.
b = beam web width, in.
b_ℓ = width of web and one ledge, in.
b_t = width of bearing area, in.
s = spacing of concentrated loads, in.
d_e = distance from center of load to end of beam, in.

If the ledge supports a continuous load or closely spaced concentrated loads, the design shear strength is:

$$\phi V_n = 24\phi h_\ell\lambda\sqrt{f_c'} \quad \text{(Eq. 5-48)}$$

where:

ϕV_n = design shear strength, lb/ft

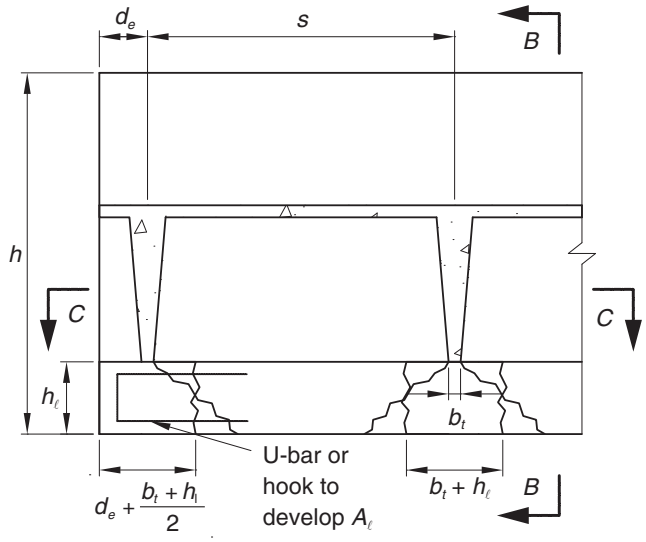
If the applied factored load exceeds the strength as determined by Eq. 5-44, 5-45, or 5-48, the ledge should be designed for shear transfer and diagonal tension in accordance with Sections 5.6.3.2 through 5.6.3.4.

5.5.2 Transverse (Cantilever) Bending of Ledge

Transverse (cantilever) bending of the ledge requires flexural reinforcement A_s, which is computed by Eq. 5-49. Such reinforcement may be uniformly spaced over a width of $6h_\ell$ on either side of the bearing, but not to exceed half the distance to the next load. Bar spacing should not exceed the ledge depth, h_ℓ, or 18 in.

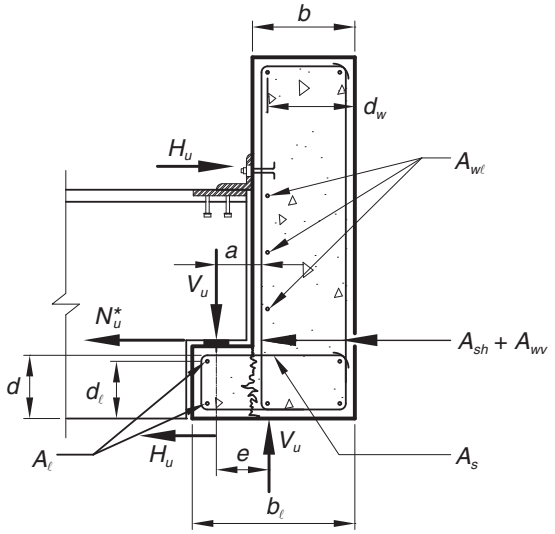
$$\frac{A_s}{\ell} = \frac{1}{\phi f_y}\left[V_u\left(\frac{a}{d}\right)+N_u\left(\frac{h_\ell}{d}\right)\right] \quad \text{(Eq. 5-49)}$$

(See Fig. 5.5.1 for definitions.)



Elevation

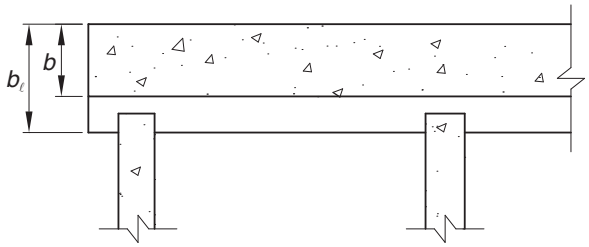
Potential shear failure surfaces in beam ledges



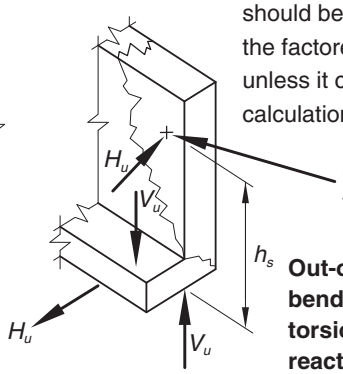
Section B-B

Equilibrium and connection reinforcement of ledger beam (Note: Reinforcement required for flexure and internal torsions not shown)

*For components on bearing pads, N_u should be taken as at least 0.2 times the factored dead load portion of V_u, unless it can be shown as less by calculation.



Section C-C



Out-of-plane bending caused by torsional equilibrium reactions

Fig. 5.5.1 Design of beam ledges.

5.5.3 Longitudinal Bending of Ledge

Longitudinal reinforcement, calculated by Eq. 5-50, should be placed in both the top and bottom of the ledge portion of the beam:

$$A_\ell = 200(b_\ell - b)\, d_\ell / f_y \qquad \text{(Eq. 5-50)}$$

where:

d_ℓ = design depth of A_ℓ reinforcement

(See Fig. 5.5.1 for other definitions.)

5.5.4 Attachment of Ledge to Web

Hanger steel A_{sh} computed by Eq. 5-51 is required for attachment of the ledge to the web. Distribution and spacing of A_{sh} reinforcement should follow the same guidelines as for A_s reinforcement in Section 5.5.2. A_{sh} is not additive to shear and torsion reinforcement designed in accordance with Sections 5.3 and 5.4.

$$A_{sh} = \frac{V_u}{\phi f_y}(m) \qquad \text{(Eq. 5-51)}$$

where:

V_u = applied factored load, lb

ϕ = 0.75

f_y = yield strength of A_{sh} reinforcement, psi

m = modification factor computed by Eq. 5-52, which is derived from Reference 17.

$$m = \frac{\left[\left(d_s + a\right) - \left(3 - 2\frac{h_\ell}{h}\right)\left(\frac{h_\ell}{h}\right)^2\left(\frac{b_\ell}{2}\right) - e\gamma_t\frac{\left(x^2 y\right)_\ell}{\Sigma x^2 y}\right]}{d_s} \qquad \text{(Eq. 5-52)}$$

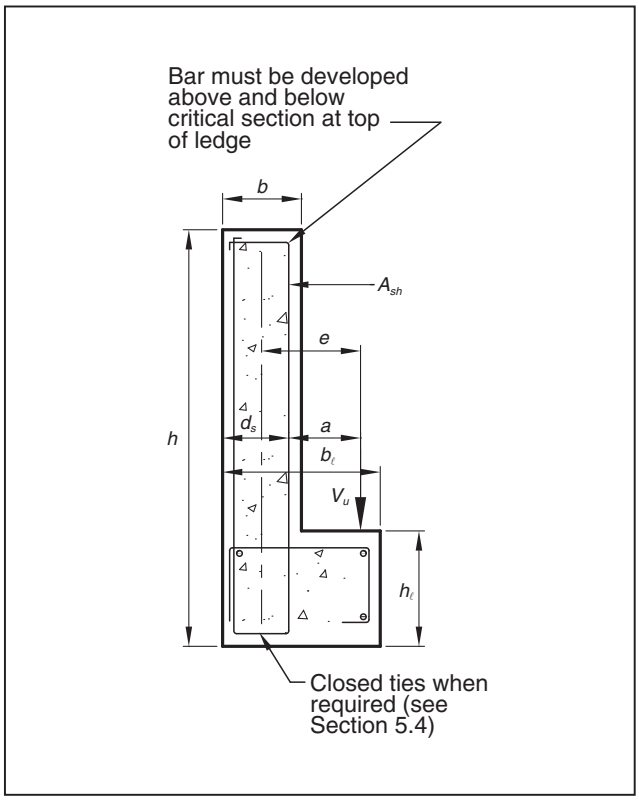


Fig. 5.5.2 Ledge hanger steel geometry.

m ≥ 0.6 for L beams.
m ≥ 0.4 for Inverted-tee beams.

where:

x, y = shorter and longer sides, respectively, of the component rectangles forming the ledge and the web parts of the beam, in.
γ_t = 0, when closed ties are not used in the ledge
γ_t = 1.0 when closed ties are used in the ledge

(See Fig. 5.5.2 for additional definitions.)

In the case of an inverted-tee beam calculate m as shown in Fig. 5.5.3.

5.5.5 Out-of-Plane Bending near Beam End

In the Reference 17 study, it was found that when the reaction is not colinear with applied loads, as illustrated in Fig. 5.5.1, the resulting out-of-plane bending may require additional vertical and horizontal reinforcement. These are computed by Eq. 5-53 and provided on the inside face of the beam. This reinforcement is not additive to the reinforcement for internal torsion. The $A_{w\ell}$ and A_{wv} bars should be evenly distributed over a height and width equal to the distance between the torsion connections h_s. See Fig. 5.5.1.

$$A_{wv} = A_{w\ell} = \frac{V_u e}{2\phi f_y d_w} \qquad \text{(Eq. 5-53)}$$

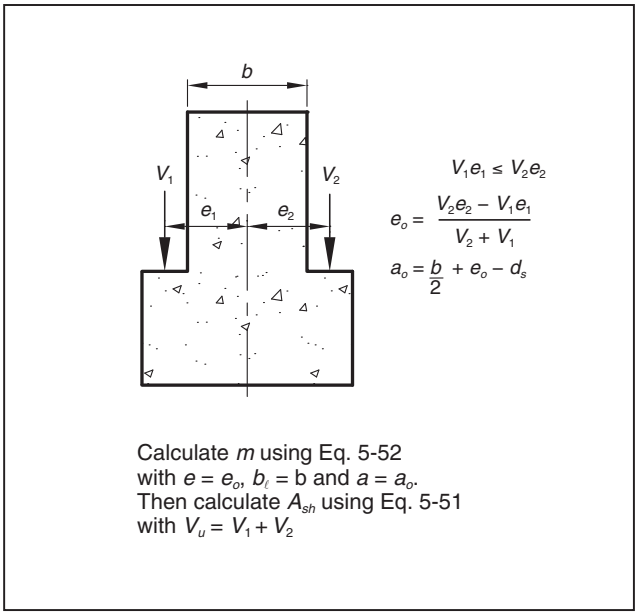


Fig. 5.5.3 Loads on an inverted-tee beam.

Terms are as shown in Fig. 5.5.1, Section B-B,

where:

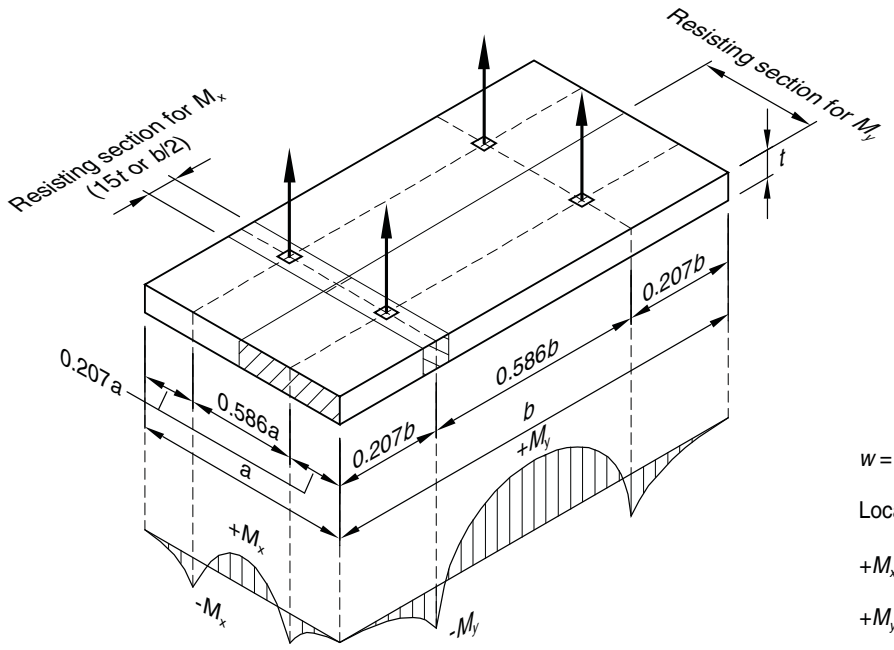
V_u = factored shear force at critical section, lb
e = eccentricity, see Fig. 5.5.1, in.
ϕ = 0.75 (The use of ϕ = 0.75 instead of 0.90 [flexure] compensates for the use of d_w in place of the actual, somewhat smaller, lever arm.)
f_y = yield strength, psi
d_w = depth of A_{wv} and $A_{w\ell}$ reinforcement from outside face of beam, in.

Note that if the out-of-plane eccentricity e is very small, then the additional reinforcement may not be required.

5.5.6 Pocketed Spandrels

As an alternative to beams with ledges, pocketed beams may be used to provide support for stemmed components. Because of double-tee erection constraints, pocketed beams can only be used to support one end of the tee. They are frequently used on the exterior line of columns in parking structures. Pocketed beams have the advantages of minimal torsion, more simplified forming, economical production, and a flush interior face.

Design procedures for pocketed spandrels is provided in Reference 17 and is illustrated in Example 5.5.6.1.



(a) Four-point pick-up maximum moments

w = weight per unit area

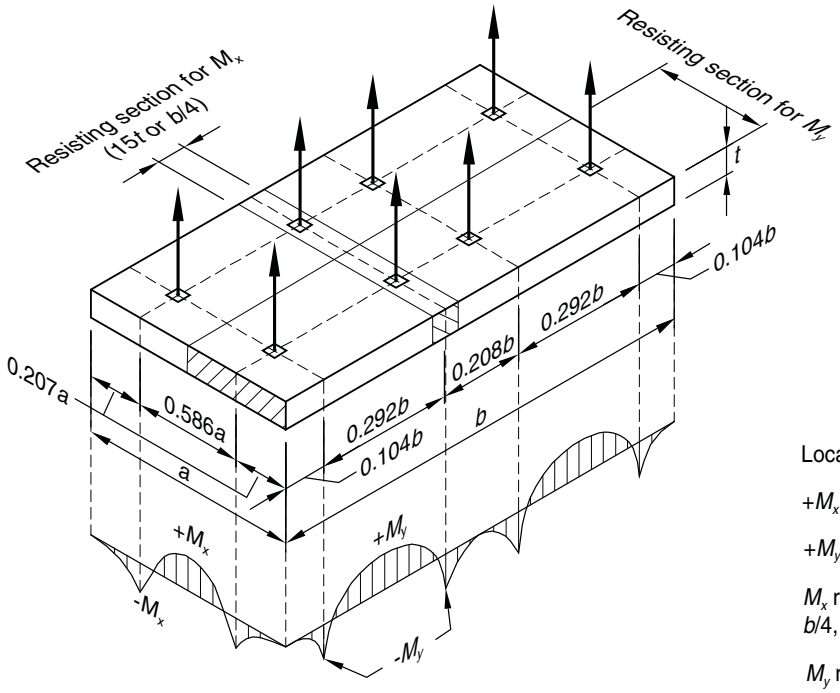
Locations shown for equal pick loads

$+M_x = -M_x = 0.0107wa^2b$

$+M_y = -M_y = 0.0107wab^2$

M_x resisted by a section of width $15t$ or $b/2$, whichever is less

M_y resisted by a section of width $a/2$



(b) Eight-point pick-up maximum moments

Locations shown for equal pick loads

$+M_x = -M_x = 0.0054wa^2b$

$+M_y = -M_y = 0.0027wab^2$

M_x resisted by a section of width $15t$ or $b/4$, whichever is less

M_y resisted by a section of width $a/2$

Fig. 8.3.2 Moments developed in panels stripped flat.

and non-compact sections, does not address lateral torsional buckling failure modes, which frequently govern spreader-beam designs since the compression flange is unbraced for its entire length. Achieving this requirement within the framework of applicable design codes is the responsibility of the designer, and there are many different solutions. The following provides an allowable stress-design approach that yields conservative results:

- For compact or non-compact sections, use $F_y/3$ as the allowable bending stress.
- For beams with the unbraced length (distance between crane pick points) greater than L_c as defined in AISC *Manual of Steel Construction Ninth Edition,*[2] the allowable bending stress can be determined from equations F1-6, F1-7, and F1-8 as appropriate and divided by 1.8 (resulting in an effective allowable bending stress that is about $^1/_3$ the stress that corresponds to buckling).
- For allowable axial stress, modify AISC allowable-stress design (ASD) Eq. E2-1 and E2-2 to have a safety factor of 3. Apply AISC ASD Eq. H1-1, H1-2, and H1-3 directly for interaction of combined bending and axial loads.

Note that newer editions of AISC's manuals may have different equations.

An additional consideration for spreader-beam design includes making the spreader beam stiffer than the concrete component to limit the deflection and stresses that may cause cracking. Also, weld stress ranges should not exceed the values listed in ANSI/AWS D14.1, *Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment.*[3] A similar philosophy should be applied for the design of connections of spreader-beam assemblies.

For analysis of a precast concrete component when using a spreader beam, the component acts as a continuous beam with multiple supports. Consideration of lifting-hook locations, hook heights, and sling angles are critical to ensure even lifting of the component.

8.3.4 Stripping Design

8.3.4.1 Form Suction and Impact Factors

To account for the forces on the component caused by form suction and impact, it is common practice to apply a multiplier to the component weight and treat the resulting force as an equivalent static load. These multipliers cannot be quantitatively derived, so they are based on experience. Table 8.3.1 provides typical values. Individual precast concrete producers may have modified factors based on its local experiences and its specific formwork.

8.3.4.2 Factors of Safety

When designing for stripping and handling, the following safety factors are recommended.

1. Use embedded inserts and erection devices with a pullout strength at least equal to four times the calculated load on the device. Note that suction factors shown in Table 8.3.1 are not to be applied in addition to the weight of the component when calculating lifting-device loads. Also note that the sling angle of the rigging may affect these values.
2. For components designed without discernible cracking, the modulus of rupture ($f_r = 7.5\sqrt{f_c'}$) is divided by a safety factor of 1.5 so that the computed stress is less than or equal to

$$\frac{7.5\lambda\sqrt{f_c'}}{1.5} = 5\lambda\sqrt{f_c'} \qquad \text{(Eq. 8-1)}$$

Table 8.3.1 Equivalent static load multipliers to account for stripping and dynamic forces[a,b]

Product type	*Finish*	
	Exposed aggregate with retarder	*Smooth mold (form oil only)*
Flat, with removable side forms, no false joints or reveals	1.2	1.3
Flat, with false joints and/or reveals	1.3	1.4
Fluted, with proper draft[c]	1.4	1.6
Sculptured and other conditions	1.5	1.7
Yard handling[d] and erection[b]		
All products	1.2	
Transportation[d]		
All products	1.5	

a. These factors are used in flexural design of panels and are not to be applied to required safety factors on lifting devices. At stripping, suction between product and form introduces forces, which are treated here by introducing a multiplier on product weight. It would be more accurate to establish these multipliers based on the actual contact area and a suction factor independent of product weight.
b. May be higher under certain circumstances.
c. For example, tees, channels, and fluted panels.
d. Certain unfavorable conditions in road surface, equipment, and the like may require use of higher values.

system (Design Aid 4.11.8)

I = seismic occupancy importance factor (Design Aid 4.11.1)

The C_d factor represents an approximation of the post-yield displacement.

In the evaluation of the building drift, the limit placed on building period by Eq. 4-17 and on the lower threshold limit Eq. 4-21 or 4-22 do not apply. A separate analysis using reduced lateral loads calculated without these constraints may be used to calculate the deflections used in the drift and stability evaluation.

Caution is needed when performing and interpreting the results of elastic analysis for precast concrete moment frames. Designers using linear elastic analysis ordinarily calculate the load distribution and displacements using the load combinations as if the structure is instantly complete. This is usually not accurate. Erection of components and completion of connections is sequential. This sequential erection procedure can result in different actual load distributions and displacements from those a designer might calculate if he/she did not consider the loading results of sequential erection and instead just analysed the loads and their results as if they were all in place simultaneously. For example, when deck components are placed on simple-span beams and moment connections later make the beam continuous, the deck load does not contribute to the negative moment at the connection. Calculated lateral forces and drifts can be similarly affected in unsymmetrical frames. Also, lateral sway may be taken out during erection as the frame is adjusted to plumb as erection proceeds. The contract drawing should state the assumed sequence of precast concrete construction.

Thus, load combinations that include the effect of gravity dead loads as created by sequential erection should be analyzed so that these effects can be subtracted from the seismic-load combinations to accurately reflect the effects of sequential erection. This can substantially reduce the design moments. Similarly, for drift derived from a linear elastic analysis, a load case or combination that includes only the seismic load should be used to separate the seismic deflections from the gravity dead-load effects.

A stability coefficient θ must be calculated:

$$\theta = \frac{P_x \Delta}{V_x h_{sx} C_d} \qquad \text{(Eq. 4-26)}$$

where:

P_x = total vertical unfactored load at and above level x

Δ = difference of deflections between levels x and x–1

V_x = seismic shear force acting between levels x and x–1

h_{sx} = story height below level x

C_d = deflection amplification factor (Design Aid 4.11.8)

The stability coefficient is limited to:

$$\theta_{max} = \frac{0.5}{\beta C_d} \le 0.25 \qquad \text{(Eq. 4-27)}$$

where β = ratio of shear demand to shear capacity between levels x and x–1

4.2.4.5 P-Δ Effects

In addition to the inelastic deformation increase, the design story drift must also be increased to account for

P-Δ effects by a factor of $\frac{1}{1-\theta}$

If $\theta < 0.10$, P-Δ effects may be neglected.

The allowable story drift limits are shown in Design Aid 4.11.9, which is taken from ASCE 7-05, Table 12.12.1.

4.2.4.6 Redundancy – Seismic Design Categories D, E, and F

In high seismic design categories, ASCE 7-05 requires the consideration of redundancy in the lateral-force-resisting system. This is done by increasing the earthquake force in seismic design categories D, E, and F by a factor ρ. The provisions for redundancy in ASCE 7-05 have been completely changed from earlier versions of the load standard. Under the ASCE 7-05 criteria, ρ is taken as 1.3 unless one of two conditions stated in Section 12.3.4.2 are met. The first condition requires that in each story resisting more than 35% of the base shear in the direction of interest, the loss of moment resistance at the beam-to-column connections at both ends of a single beam in a moment-resisting frame, or the removal of a shear wall not result in more than 33% reduction in story shear nor does the resulting system have an extreme torsional irregularity (Type 1b). This irregularity is not permitted in seismic design categories D, E, and F. The second condition requires that structures that are regular in plan have at least two bays of seismic-force-resisting perimeter framing on each side of the structure in each orthogonal direction at each story resisting more than 35% of base shear.

Unless a building has structural irregularities, most practical layouts with precast concrete framing will meet the first condition and will not require the ρ factor to be other than 1.0.

4.2.5 Lateral Soil Loads

Some precast concrete structures require the consideration of lateral soil pressures. Design procedures involving soil loads are beyond the scope of this handbook and can be found in many texts and references.

4.2.6 Load Combinations

References 1 and 3 specify the following load combinations:

1. $U = 1.4(D + F)$ (Eq. 4-28)
2. $U = 1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$ (Eq. 4-29)
3. $U = 1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (1.0\,L \text{ or } 0.8W)$ (Eq. 4-30)

4. $U = 1.2D + 1.6W + 1.0L + 0.5(L_r \text{ or } S \text{ or } R)$ (Eq. 4-31)
5. $U = 1.2D + 1.0E + 1.0L + 0.2S$ (Eq. 4-32)
6. $U = 0.9D + 1.6W + 1.6H$ (Eq. 4-33)
7. $U = 0.9D + 1.0E + 1.6H$ (Eq. 4-34)

Except as follows:

- The load factor on the live load L in Eq. 4-30 to 4-32 shall be permitted to be reduced to 0.5 except for garages, areas occupied as places of public assembly, and all areas where L is greater than 100 lb/ft^2.
- Where wind load W has not been reduced by a directionality factor, it shall be permitted to use $1.3W$ in place of $1.6W$ in Eq. 4-31 and 4-33.
- Where E, the load effects of earthquake, is based on service-level forces, $1.4E$ shall be used in place of $1.0E$ in Eq. 4-32 and 4-34.
- The load factor on H, loads due to weight and pressure of soil, water in soil, or other materials, shall be set equal to zero in Eq. 4-33 and 4-34 if the structural action due to H counteracts that due to W or E. Where lateral earth pressure provides resistance to structural actions from other forces, it shall not be included in H but shall be included in the design resistance.

where:

D = dead load
F = pressure of fluids of known density and controlled depths
T = effects of temperature, creep, and shrinkage
L = live load
H = soil load
L_r = roof live load
S = snow load
R = rain load
W = wind load
E = seismic load

IBC 2006 requires that the value of E in Eq. 4-32 and 4-34 be defined by:

$$\rho Q_E \pm 0.2S_{DS}D \quad \text{(Eq. 4-35)}$$

Note that $0.2S_{DS}D$ accounts for the vertical acceleration affecting the dead-load contribution.

This has the effect of changing those equations to:

$$U = (1.2 + 0.2S_{DS})D + \rho Q_E + f_1 L + 0.2S \quad \text{(Eq. 4-32a)}$$

$$U = (0.9 - 0.2S_{DS})D + \rho Q_E + 1.6H \quad \text{(Eq. 4-34a)}$$

The coefficient ρ is 1.0 for buildings in seismic design categories A, B, and C. See Section 4.2.4.5 for calculation of ρ in high seismic design categories D, E, and F. Q_E is the horizontal seismic force on the component or system.

4.2.6.1 Load Factors for Diaphragms

Although not required by code, recent research into the performance of some precast concrete diaphragms in high seismic areas indicate that the use of special load combinations should be considered. To distinguish the diaphragm overstrength factor from the system overstrength factor, ψ is introduced to represent the diaphragm overstrength factor (see Section 4.8).

$$U = 1.2D + f_1 L + E_\psi \quad \text{(Eq. 4-36)}$$

$$U = 0.9D + E_\psi \quad \text{(Eq. 4-37)}$$

where:

$$E_\psi = \varphi Q_E \pm 0.2S_{DS}D \quad \text{(Eq. 4-38)}$$

For design of the diaphragm in shear-wall buildings, which includes chord reinforcement and shear connections between precast concrete elements, Section 4.8 recommends a diaphragm overstrength factor $\psi = 2.0$ in the previous equation for seismic design categories D, E, and F. The value for the diaphragm force for any seismic design category should not be less than F_{px} calculated by Eq. 4-60 or the largest level seismic force, whichever is greater and still within the limits of $0.25S_{DS}I_E F_{px} \le F_{px} \le 0.4S_{DS}I_E W_{px}$. It is recommended that the same force be used for diaphragm design for all levels of the building.

Since the diaphragm overstrength factor is not recommended for seismic design categories A, B, and C, it is suggested, based on versions of Reference 5, that perimeter diaphragm reinforcement be designed based on strength-reduction factors ϕ as follows: For continuous bars, $\phi = 0.9$. For bars spliced with mechanical or welded connections, $\phi = 0.7$. For shear design in diaphragms, $\phi = 0.60$ for shear friction reinforcement and for mechanical connectors in the joints to ensure additional overstrength for shear.

For connections from the collectors to the SFRS—shear walls or moment frames—References 1 and 5 require that the equations shown previously be used with E_m instead of E_ψ in seismic design categories C and higher. Collectors in seismic design catagories A and B do not require any overstrength factor to be applied. The value of E_m is determined with Ω_o, the system overstrength factor (listed in Design Aid 4.11.8).

4.3 Structural Integrity

4.3.1 Introduction

It is the intent of the structural integrity provisions of ACI 318-05 to improve the redundancy and ductility of structures, thereby reducing the risk of failure or collapse of parts or all of a building due to damage occurring to a relatively small area of a building. ACI 318-05 commentary emphasizes that the overall integrity of the structure can be substantially enhanced by minor changes in the detailing of reinforcement. In the event of damage to a beam, for example, it is important that displacement of its supporting component be minimized, so that other components will not be affected. For this reason, connection

ally much less than that requiring P-Δ consideration, but it must be checked.

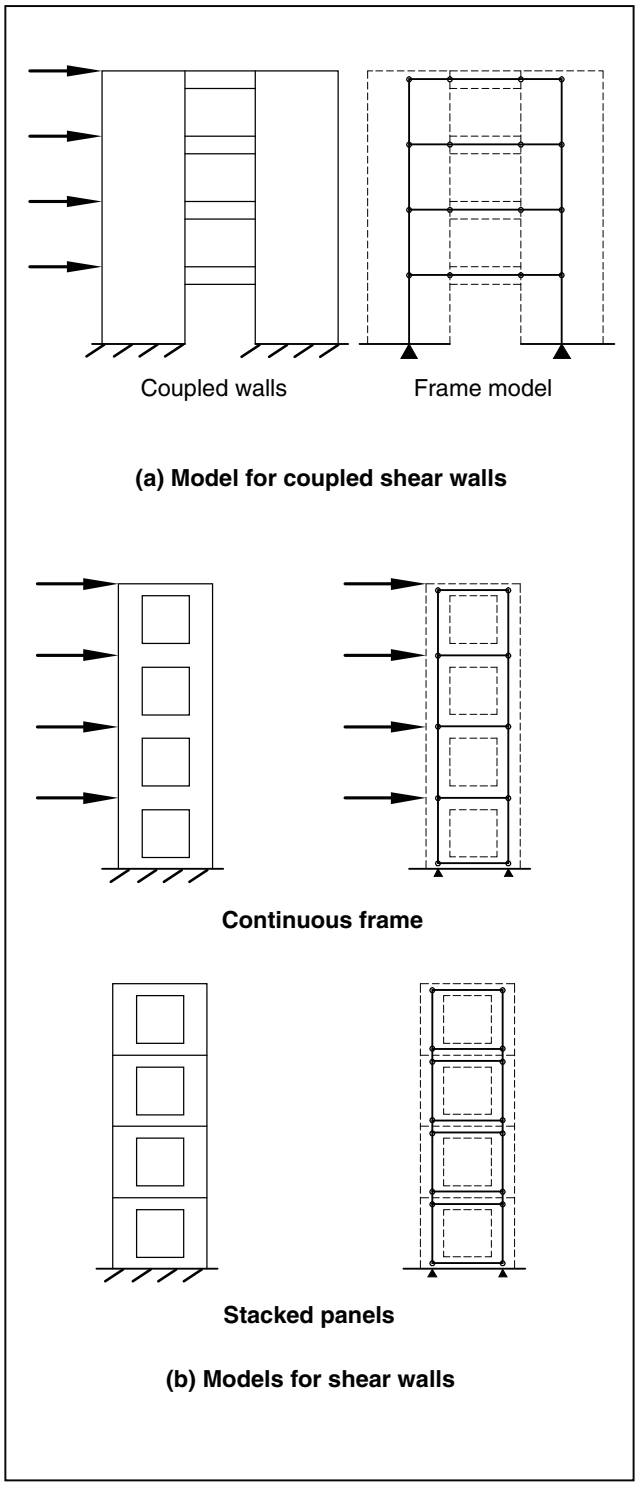


Fig. 4.5.6 Computer models – shear walls.

4.5.11 Example: One-Story Building

By taking advantage of walls already present, one-story buildings usually can be designed to resist lateral loads (wind or earthquake) by shear wall and diaphragm action. If this is feasible, it is generally the most economical solution. Example 4.5.11.1 illustrates the procedures.

Because all loads must funnel through the connections, gravity and lateral loads must be considered together. Thus, this example shows both gravity and lateral-load connections. The example emphasizes the concepts of free-body diagrams and load paths.

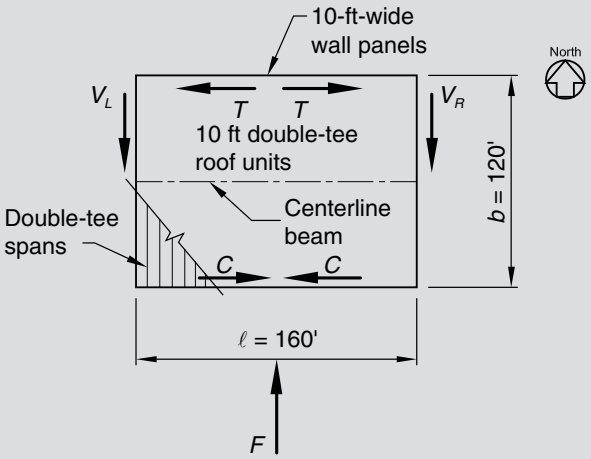
This example illustrates one option for shear-wall connections. Equilibrium is attained by balancing uplift tension in one panel with the matching compression couple force in an adjacent panel through simple (and ductile) shear connections across the vertical joints. In this system, tie-down connections may be required.

Analysis of a rigidly connected panel group is dependent on a number of factors. Connection stiffness determines whether the group will act monolithically or act as a series of single shear walls. The aspect ratio of the rigidly connected group will affect the stress distribution at the base. While a panel group with a high height-to-length ratio may nearly act as a cantilever beam, a group with a medium-to-low ratio of height to length will act as a deep beam and exhibit nonlinear stress distributions. Determination of tie-down forces, vertical joint forces, and base shear distribution will be a function of the aspect ratio. The shear and flexural stiffness of the individual panels will have a similar effect on force distribution.

EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building

Given:
The single-story manufacturing building shown. The basic wind speed (Design Aid 4.11.5) is 120 mph, exposure B. From seismic maps, S_s = 0.30 and S_1 = 0.08, site class D. 10-ft-wide double-tees are used on the roof, weighing 47 lb/ft². Wall units are 10-ft-wide sandwich panels with a 4-in.-thick interior wythe, 2 in. insulation, and a 2-in.-thick exterior wythe, weighing an average of 75 lb/ft². A dead load of 10 lb/ft² is superimposed on the roof. Soil weight is taken as 100 lb/ft³.

Problem:
Design components and connections for critical lateral load.

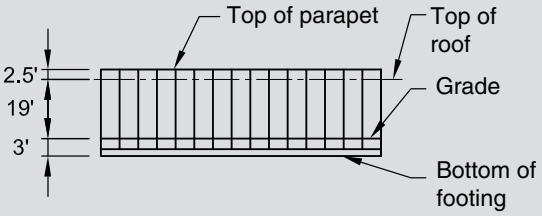


Plan

Solution:

1. Using the simplified procedure of Section 4.2.3.1 for wind design, determine from Design Aids 4.11.6 and 4.11.1:

λ	= 1.0
Zone A p_{s30}	= 22.8 lb/ft²
Zone C p_{s30}	= 15.1 lb/ft²
I	= 1.0
K_Z	= 1.0 (see Example 4.2.3.1)



Elevation

Mean roof height = 19.0 ft

Zone A width = lesser of 0.2(120) = 24 ft or
0.8(19.0) = 15.2 ft. Use 15.2 ft.

Zone C width = 160 – 15.2 = 144.8 ft
p_s(A) = $\lambda K_{ZT} I p_{s30}$ = 1.0(1.0)(1.0)(22.8) = 22.8 lb/ft²
p_s(C) = 1.0(1.0)(1.0)(15.1) = 15.1 lb/ft²

Wind force to roof:
= [15.2(22.8) + 144.8(15.1)](19/2 + 2.5)/1000 = 30.4 kip

2. Determine earthquake force: interpolating from Design Aid 4.11.7, F_a = 1.60, F_v = 2.4.

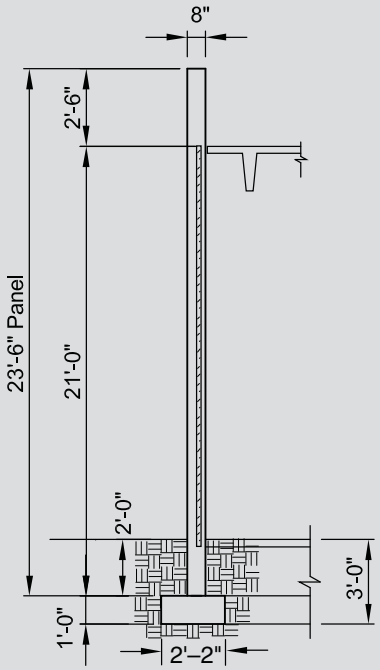
S_{MS}	= $F_a S_s$ = 1.6(0.30) = 0.48
S_{M1}	= $F_v S_1$ = 2.4(0.08) = 0.192
S_{DS}	= $^2/_3(S_{MS})$ = 2(0.48)/3 = 0.320
S_{D1}	= $^2/_3(S_{M1})$ = 2(0.192)/3 = 0.128

From Table 4.2.1: Seismic design category B

Period, $T_a = C_T(h_n)^{3/4}$ = 0.020(21.0)$^{3/4}$ = 0.196 sec

From Design Aid 4.11.1, I = 1.0

From Design Aid 4.11.8, for a bearing-wall system with ordinary precast concrete shear walls: R = 3
From Eq. 4-18:



EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building (cont.)

$$C_s = \frac{S_{DS}}{R/I} = \frac{0.320}{3/1.0} = 0.107$$

From Eq. 4-19:

$$C_s = \frac{S_{D1}}{(R/I)T} = \frac{0.128}{(3/1.0)0.196} = 0.218$$

From Eq. 4-21:
Minimum $C_s = 0.044\ S_{DS}I = 0.044(0.320)(1.0) = 0.014 > 0.01$
Therefore, minimum $C_s = 0.014 < 0.107$. Use $C_s = 0.107$

Building weight:
Walls = 75(23.5)[2(160) + 2(120)]/1000 = 987 kip (50% goes directly into foundation)
Roof = 120(160)(47 + 10)/1000 = 1094 kip
Beams and columns (estimated load contribution to roof) = 150 kip

ASCE 7-05 Section 12.7.2 requires that 20% of snow load be considered if the snow load is greater than 30 lb/ft The snow load for this example is considered to be less than 30 lb/ft.

$$W = \frac{987}{2} + 1094 + 150 = 1738 \text{ kip}$$

Base shear $V = C_sW = 0.107(1738) = 186.0$ kip

3. In a single-story building, the total base shear acts through the roof diaphragm. For a single-span diaphragm such as this, design is straightforward. For buildings with interior shear walls, it is more complex (see Section 4.8). For seismic forces, note the requirements for torsion analysis in Section 4.2.4.3. (No such requirement exists for wind load.) Assuming no substantial door openings in either shear wall, the center of mass is the center of the building. However, the 5% accidental torsion must be considered.

Accidental torsion = 0.05(160) = 8.0 ft. Thus, assume the center of mass is 88 ft from the left wall and 72 ft from the right wall.

$$V_R = \frac{186.0(88)}{160} = 102.3$$

As can be seen in Section 4.2.6, seismic forces thus calculated are factored (load factor = 1.0 for this seismic category), while a load factor of 1.6 is applied to the wind forces. The wind force is distributed equally to each shear wall:

1.6(30.4/2) = 24.3 kip
102.3 > 24.3 kip, seismic loading is critical.

For the seismic diaphragm design (chord steel and shear connectors between roof tees) for this single-story building, use F_{px} calculated by Eq. 4-60 or the total base shear, whichever is greater: (Note that in the case of a single-story structure, Eq. 4-60 will always yield the total base shear.)
Check minimum F_p:
$F_p = 0.2I_ES_{DS}W_P = 0.2(1.0)(0.32)(1738) = 111.2$ kip < 186.0 kip (governs)

EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building (cont.)

4. Check sliding resistance of the foundation:

Dead load on the footing:

Wall	= 75(23.5)(120)	= 211,500 lb
12 in. × 18 in. footing	= 1(1.5)(150)(120)	= 27,000 lb
Assume 2 ft backfill	= 100(1.5)(120)(2)	= 36,000 lb
		Total = 274,500 lb

Assume coefficient of friction against granular soil, $\mu_s = 0.5$
Sliding resistance = $\mu_s N = 0.5(274.5) = 137.2$ kip > 102.3 OK
(Note: This analysis is a close approximation. More detailed analysis may be required.)

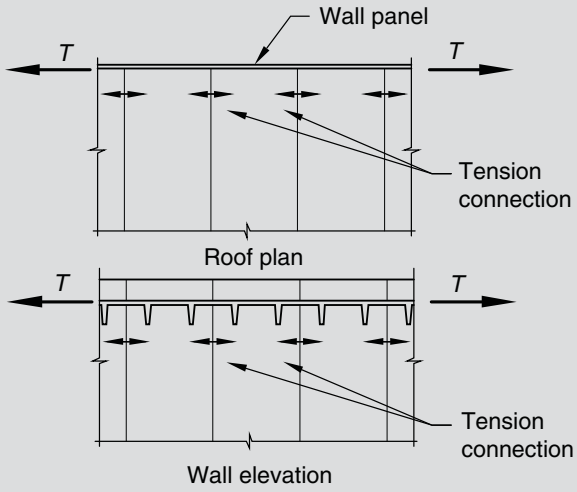
From Eq. 4-34a: $U = (0.9 - 0.2S_{DS})D - \rho Q_E = [0.9 - 0.2(0.32)]137.2 - 1.0(102.3) = 12.4 > 0$ OK

Determine the reinforcement and connection requirements for the diaphragm.

a. Connections from the roof to the walls:

A connection similar to that shown in Example 6.13.3 may be used.
That connection has a maximum capacity of
13.2 kip. On east and west walls, connections required = $\frac{V_R}{\text{conn. cap.}} = \frac{102.3}{13.2} = 7.7$

Use maximum spacing of about 10 ft. Approximately ten connections required per side. Use two connections per panel and check that structural integrity requirements are satisfied.



Alternative placement of chord reinforcement

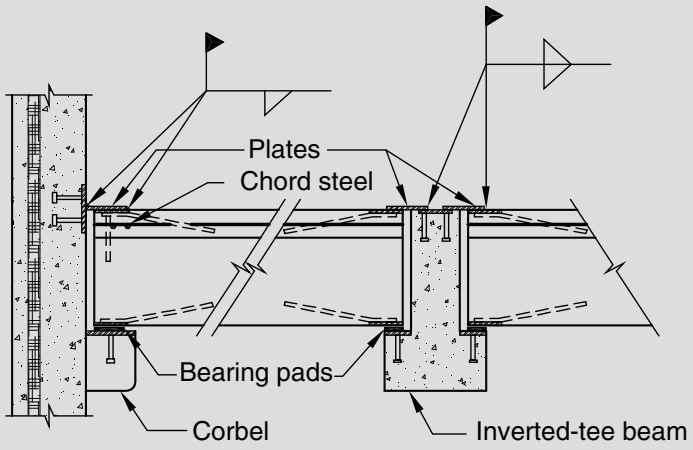
b. Shear connections between double-tees:
The maximum shear is at first joint (10 ft) from left wall. The left wall is 88 ft from the center of force. Assuming a uniformly distributed lateral force:

$$\text{Shear} = \frac{(88-10)}{88}(102.3) = 90.7 \text{ kip}$$

A connection similar to one of those shown in Fig. 4.8.2 may be used.

Note: Most engineers and precasters prefer a maximum connection spacing of about 8 to 15 ft for roof connections.

EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building (cont.)



Section at wall Section at ledger beam

Structural integrity ties

c. To determine chord reinforcement, the seismic force is assumed to be distributed uniformly across the building width *b*:

Diaphragm moment:

$$\frac{F\ell}{8} = \frac{186.0(160)}{8} = 3720 \text{ kip-ft}$$

Chord force (see plan):
Assume chord reinforcement is located 1 ft in from outside of wall. Since these are seismic forces, they can be considered factored:

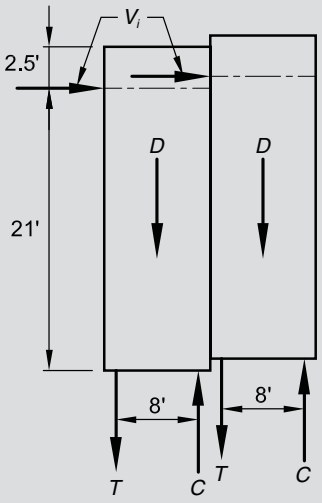
$$T_u = C_u = \frac{M}{b-2} = \frac{3720}{120-2} = 31.5 \text{ kip}$$

Assume bars will be spliced by welded connections and recommendations of NEHRP 2000 will be followed;
ϕ = 0.7 (Section 4.2.6.1):

$$A_s = \frac{T_u}{\phi f_y} = \frac{31.5}{0.7(60)} = 0.75 \text{ in.}^2$$

This amount of reinforcement should be placed at the perimeter. The chord force can be transmitted between components by ties at the roof tees, wall panels, or a combination, as illustrated. These ties and transmission of forces will usually provide the tie requirements for structural integrity outlined in Section 4.3.

EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building (cont.)



d. Wall panel connections:

This shear wall may be designed to act as a series of independent units, without ties between the panels. The shear force is assumed to be distributed equally among the wall panels (see figure).

n = 120/10 = 12 panels
V = V_R/n = 102.3/12 = 8.53 kip/panel
D = 75(10)(23.5)/1000 = 17.62 kip

Note that the engineer responsible for the foundation design must confirm that it is designed to be compatible with the wall behavior.

From Eq. 4-34a, D is multiplied by:

$(0.9 - 0.2S_{DS}) = [0.9 - 0.2(0.320)] = 0.836$
$D = 0.836\ (17.62) = 14.73$ kip

Design base connection for $1.0E - (0.9 - 0.2S_{DS})D$

$$T_u = \frac{8.53(21) - 14.73(4)}{8} = 15.0 \text{ kip}$$

As an alternative, the shear walls may be designed with two or more panels connected together. The following figure illustrates an analysis where tension and compression counteract one another with simple shear connections across the vertical joints. For simplicity, it is assumed that the walls have no openings. Thus, there are interior and exterior (corner) wall panels. Connections are made across the vertical panel joints to take advantage of the fact that compensating forces are generated in the panels.

Note: Determining connection forces requires solving classic equations of equilibrium. This will be done using factored loads that assume connection tension. Compression forces are assumed to be no problem, as the joint between the wall panel and the foundations is normally grouted.

Considering an interior panel:

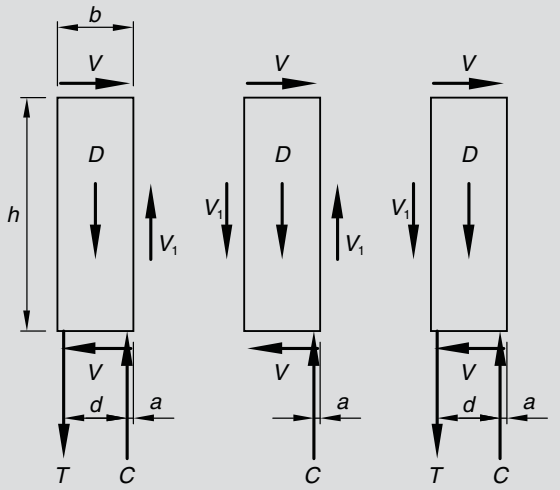
ΣM about C = 0: $V(h) = V_1(b - a) + D(b/2 - a) + V_1 a$

$$V_1 = \frac{V(h) - D(b/2 - a)}{b}$$

$\Sigma V = 0$: $C = D$

EXAMPLE 4.5.11.1
Typical Single-Story Industrial Building (cont.)

Since this force system can exist for all interior panels, edge shears will balance to zero when all panels have the same dimensions and weight. The only requirement for the connections is a transfer of vertical shear. Therefore, connections that permit horizontal deformations can be used if volume-change restraint is of concern. At the exterior panels, the edge shear V_1 from an exterior panel will be applied at one edge only. Because tension and compression base connections are not located at the panel edges, equilibrium may have to be satisfied with tension and compression connections to the foundation or connections to the orthogonal panel that will allow the non-shear wall to contribute additional dead load at the corner.



At the tension-side of the exterior panel, equilibrium can be determined by summing moments about the compression force, assuming the tension is taken by a tie-down into the foundation:

For this example, locate the foundation connections 1 ft from each side. The pertinent dimensions are:

h = 21 ft; b = 10 ft; a = 1 ft; d = 8 ft
V = 8.53 kip, D = 14.73 kip

Using Eq. 4-34:

$V_u = 1.0(8.53) = 8.53$ kip
Factored dead load = 14.73 kip (see p. 4-35)

For interior panels with factored loads (Fig. b):

$$V_1 = \frac{8.53(21) - 14.73(5-1)}{10} = 12.02 \text{ kip}$$

C = D

For the tension-side of the exterior panel (Fig. a):

$$T_u = \frac{8.53(21) - 14.73(5-1) - 12.02(1)}{8}$$

$$= 13.52 \text{ kip}$$

$$C_u = T_u + D_u + V_1 = 13.52 - 14.73 - 12.02$$

$$= 16.23 \text{ kip}$$

For the compression side exterior panel:

$$T_u = \frac{8.53(21) - 14.73(5-1) - 12.02(10-1)}{8} = 1.50 \text{ kip}$$

$$C_u = T_u + D_u + V_1 = 1.50 + 14.73 + 12.02 = 28.25 \text{ kip}$$

If all vertical elements of a structure exhibit the same behavior under load, that is, if they are all frames or all shear walls, the load can be distributed to the units in proportion to their stiffnesses (Section 4.5.7). However, because of the difference in bending modes, the load distribution in structures with both frames and shear walls is considerably more complex. References 23 and 25 through 28 address this issue in detail.

4.8 Diaphragm Design

In structural systems, the framing of floor and roof components provides a function beyond the support of the gravity loads. The horizontal framing is designed as a diaphragm to collect and transmit lateral forces from wind or earthquakes to the vertical components of the lateral-force-resisting system. It also provides lateral bracing to the vertical elements and protects them against abnormal loading.

Precast concrete diaphragm systems are as varied as the components that form the horizontal framing. Hollow-core floors may be designed as diaphragms with perimeter reinforcing and grouted joints, or may be the form for reinforced cast-in-place topping. Double-tee systems may include untopped or pretopped tees, pretopped tees with pour strips at the ends, or tees with cast-in-place topping that can be designed as the diaphragm.

In many precast concrete structures, the configuration and behavior of the diaphragm may be very simple. Rectangular floors or roofs spanning between precast concrete frames or walls provide connectivity and lateral-load distribution and can easily be modeled as a deep horizontal beam. In other cases, the features of the structure may create more complex conditions. The features may include excessive horizontal spans between the vertical components of the lateral-force-resisting system, large openings or discontinuities, large torsion effects from the eccentricity of the lateral force with respect to the center of stiffness, or lateral transfer requirements due to vertical discontinuities.

4.8.1 Simple Diaphragm Design – The Horizontal Beam Analogy

The diaphragm is analyzed by considering the roof or floor as a deep horizontal beam, analogous to a plate girder or I-beam. The shear walls making up the components of other lateral-force-resisting systems are the supports for this beam. As in a beam, tension and compression are induced in the chords or flanges of the analogous beam. The shear in the diaphragm is resisted by the web of the analogous beam. A diaphragm model using the beam is shown in Fig. 4.8.1.

4.8.1.1 Shear Transfer between Components

In precast concrete floors and roofs without composite topping, the individual components composed of a floor or roof diaphragm must be connected together to act as a single diaphragm. Joints between precast concrete components, which are parallel to the lateral-force-resisting system, must contain connections to resist the diaphragm shear forces as well as chord tension/compression forces at the edges of the diaphragm. Joints between the precast concrete components that are perpendicular to the lateral-force-resisting system must contain connections to resist horizontal shear (VQ/I).

The types of connections used to connect precast concrete components together to form diaphragms vary depending on the required connection strength, strain capacity to accommodate expected joint movement, and the preference of the precast concrete supplier manufacturing and erecting the precast concrete units. Two commonly used welded connections are shown in Fig. 4.8.2.

Connections between components often serve functions in addition to the transfer of shear caused by lateral loads. For example, weld plates in flanged components are often used to distribute concentrated loads and to adjust differential camber. Grout keys may be utilized in the joints to distribute concentrated loads.

Precast concrete components may be fabricated with grout keys and connected by grouting the joint. For components connected by grout keys, a conservative value of 80 psi can be used for the design shear strength of the grouted key. If necessary, reinforcement placed as shown in Fig. 4.8.3 can be used to transfer the shear. This steel is designed by the shear-friction principles discussed in Chapter 5.

In floors and roofs with composite topping, the topping itself, or in conjunction with the precast concrete components, can act as the diaphragm if adequately reinforced. Shear reinforcement can be determined by shear-friction analysis. Continuous reinforcement at the diaphragm boundaries is provided to resist chord tension forces.

Connections that transfer shear from the diaphragm to the shear walls or other lateral-force-resisting systems should be analyzed in the same manner as the connections between components. For rigid diaphragms, the reaction forces will be determined from the diaphragm design force with consideration of the maximum effects of torsion in the plane. For flexible diaphragms, the reactions are derived based on the tributary spans of the diaphragm between the vertical components. Vertical components that are within 5% of the length of the building perpendicular to their line of action to each other can be considered as the same line of resistance in this analysis.

4.8.1.2 Chord Forces

Chord forces are calculated as shown in Fig. 4.8.1. For roofs with intermediate supports as shown, the shear stress is carried across the beam with weld plates or bars in grout keys (section A-A of Fig. 4.8.1). Bars are designed by shear friction.

In decks consisting of flanged deck components, the chord tension at the perimeter of the building is usually transferred between components by reinforcement in the topping or pour strips or with tension connections.

In all buildings, a minimum amount of perimeter reinforcement is required to satisfy structural integrity requirements (Section 4.3). These minimum requirements may be more than enough to resist the chord tension.

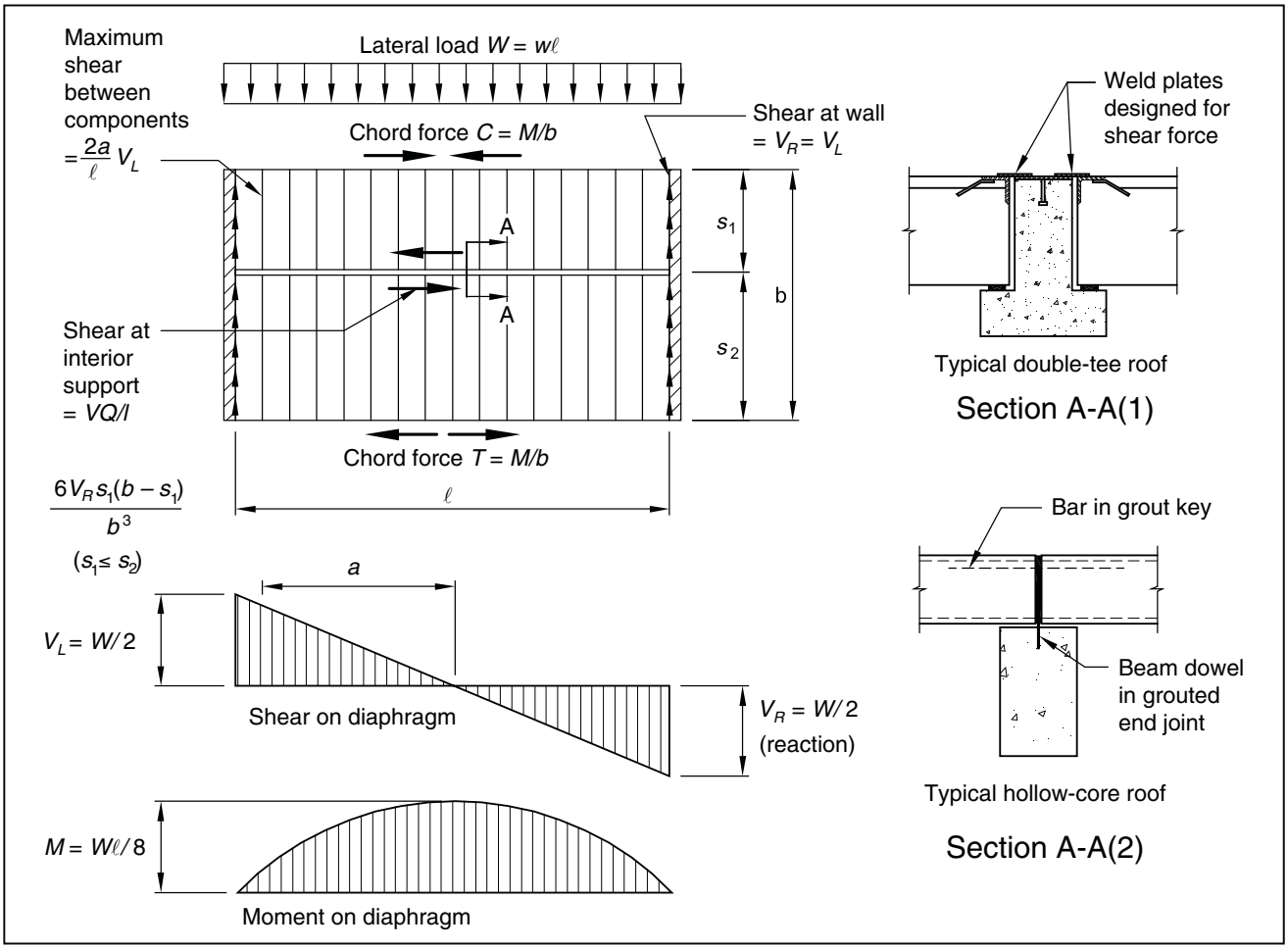


Fig. 4.8.1 Analogous beam design of a diaphragm.

4.8.1.3 Collector Forces

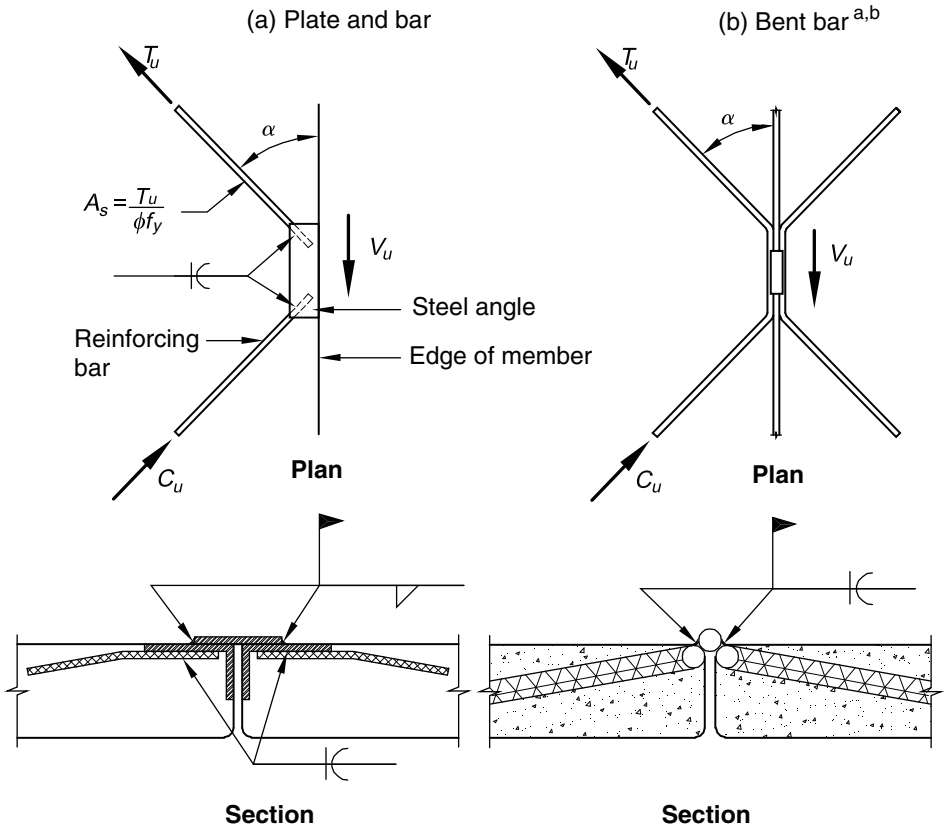
Diaphragm forces are distributed throughout the diaphragm based on the distribution of the seismic weight at the level and location under consideration. Thus, there is a requirement to provide a positive load path for these area loads into the components making up the lateral-force-resisting system. This design issue is similar to the design of hanger reinforcement in a dap design; however, only the collected portion of the demand requires drag reinforcement as opposed to using the entire reaction, as in the case of a dap (Fig. 4.8.4). Collector reinforcement should be proportioned based on the area of diaphragm for which loads are being collected. In seismic design categories C and higher, the collector demands must include the overstrength factor Ω_0 to ensure elastic behavior under a maximum earthquake event. There is also a requirement that the collector transfers load to the vertical resisting component. The Ω_0 only applies to the collector; thus, the transfer of load between the diaphragm and the shear wall only requires Ω_0 on the portion of the demand that requires collection. In some instances, there are existing components in the diaphragm that can satisfy this requirement; however, supplemental tension ties typically are necessary. Figure 4.8.5 shows collector (drag) reinforcing into and adjacent to a shear wall. While shown in the topping, it can be in the component adjacent to the shear wall. Often, collector and chord forces can be resisted by the same tensile tie since collectors are typically oriented parallel to the applied lateral load and chords are typically perpendicular; they do not tend to be additive demands.

4.8.2 Rigid and Flexible Diaphragms

Since the inception of the precast and prestressed concrete industry, building structures have typically been designed using the assumption that the floor systems serve as rigid diaphragms between the vertical components of the lateral-force-resisting system. A diaphragm is classified as rigid if it can distribute the horizontal forces to the vertical lateral-load-resisting elements in proportion to their relative stiffness. Close examination of the effective properties of diaphragms, along with long-span applications, suggest that many precast concrete diaphragms may be flexible.

4.8.2.1 Defining Rigid or Flexible Diaphragms

A diaphragm is flexible for the purpose of distribution of story shear when the lateral deflection of the diaphragm under lateral load is more than twice the average story drift of adjoining vertical components of the lateral-force-



Note:
a. Not suitable for diaphragms in high-seismic areas, pending further research.
b. Recommendations for welding of reinforcing bars in Section 6.7.3 must be closely followed.

Fig. 4.8.2 Typical flange weld plate details. See Chapter 6 of this handbook for design of welds and connections.

resisting system under equivalent, tributary lateral loads. A rigid diaphragm is one that is not flexible. The distinction between rigid and flexible diaphragms is important not just for diaphragm design but also for the design of the entire lateral-force-resisting system.

For structures with rigid diaphragms, the seismic-design story shear is distributed to the various vertical components of the lateral-force-resisting system based on the relative lateral stiffnesses of the vertical resisting elements. The general assumption is that the deformation within the diaphragm is not significant, relative to that of the vertical system. This assumption implies that the diaphragm is capable of carrying loads to extreme points even when there are large differences in stiffness between individual vertical components. It also implies that the deformation in the diaphragm does not have a significant effect on drift, so that gravity components remote from the vertical lateral-force-resisting system are not subject to significantly larger lateral displacements. These assumptions may not be conservative.

For flexible diaphragms, the seismic-design story shear is distributed to the various vertical components based on the area of the diaphragm tributary to each line of resistance.

Section 12.3.1.2 of ASCE 7-05 states that diaphragms with an aspect ratio of 3 or less are permitted to be considered rigid. It has been demonstrated in research studies that simply limiting the aspect ratio is not sufficient, since deflection is also a function of the actual span. Research by Fleischman et al[29] has defined more precise parameters to identify flexible systems.

4.8.2.2 Behavior and Design Considerations

The behavior of diaphragms as rigid or flexible depends on many factors, including span, aspect ratio, jointing, and connections. Consider a precast concrete structure with shear walls at several lines of lateral support. Figure 4.8.6 shows a parking structure layout with stiff end walls and interior cruciform walls. The framing layout includes an interior ramp between grid lines 4 and 9, introducing a large interior discontinuity in the diaphragm.

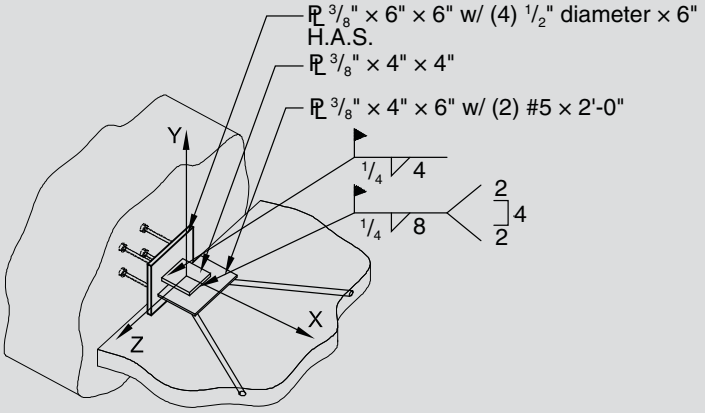
It is not uncommon to use the walls as part of the gravity system so that the dead load of the structure helps resist overturning. Such a design could result in the interior cruciform walls being significantly less stiff than the end walls. For a rigid diaphragm

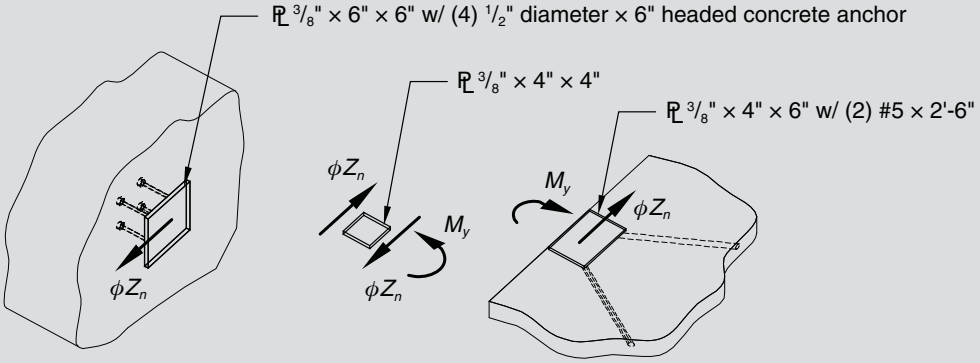
6

EXAMPLE 6.13.3
Diaphragm-to-Wall Shear Connection – Reference Sections 4.5 and 4.8

Given:
The typical diaphragm connection to shear wall shown.
Wall thickness: 8 in.
Studs: f_{ut} = 65 ksi
Reinforcing bar Grade 60: f_y = 60 ksi
Plates ASTM A36: F_y = 36 ksi
Weld material: E70 - plate to plate
E90 - rebar to plate
Concrete: f_c' = 5000 psi, normalweight

Problem:
Determine the shear capacity in the Z direction.



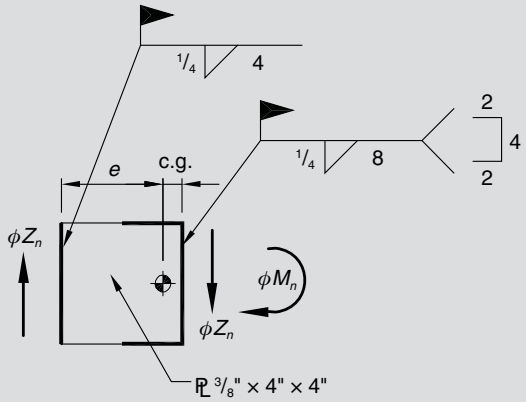


Solution:

The flange plate assembly should be detailed so that the lines of the diagonal bars intersect at a point on the face of the wall. If this is done properly, there will theoretically be no moment transferred to the wall. Because of residual moments due to tolerances, the wall and flange plate assemblies should have some moment-resisting capacity.

Because of the manner in which the erection plate is welded to the two assemblies, there is a moment in the erection plate and the weld group. The following assumptions are used:

- The erection plate is fixed at one end.
- The eccentricity of the connection is the distance between the centroids of the weld groups.



Erection-plate moment strength:

$$\text{center of gravity (c.g.)} = \frac{2b\left(\frac{b}{2}\right)}{d+2b} = \frac{2(2)\left(\frac{2}{2}\right)}{4+2(2)} = 0.5 \text{ in.}$$

e = 4 – c.g. = 4 – 0.5 = 3.5 in.

$\phi M_n \le \phi M_p$

$\phi M_n = \phi Z_n(e)$

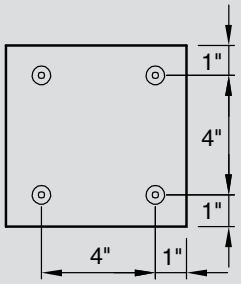
$$\phi M_p = \phi F_y Z_p = \phi F_y\left(\frac{bd^2}{4}\right)$$

EXAMPLE 6.13.3
Diaphragm-to-Wall Shear Connection – Reference Sections 4.5 and 4.8 (cont.)

$$\phi M_p = 0.9(36)\left(\frac{0.375(4)^2}{4}\right) = 48.6 \text{ kip-in.}$$

$$\phi Z_n(e) \le \phi M_p = 48.6 \text{ kip-in.}$$

$$\phi Z_n = \frac{48.6}{e} = \frac{48.6}{3.5 \text{ in.}} = 13.9 \text{ kip}$$



PL 3/8" × 6" × 6" with (4) 1/2" diameter × 6" headed concrete anchor

Erection-plate shear strength:

$$\phi Z_n = \phi(0.6F_y)A_{plate} = 0.9(0.6)(36)\frac{3}{8}(4) = 29.2 \text{ kip}$$

Weld strengths:

Wall embed to erection plate, 1/4 in. fillet weld, 4 in. long.
From Design Aid 6.14.2: $\phi Z_n = 4(5.57) = 22.3$ kip

Double-tee embed to erection plate:

This C-shaped weld can be designed by either of the methods shown in Section 6.7.5. The *LRFD Manual of Steel Construction* also contains tabulated values and design aids for determining the shear strength of such welds. Using one of those methods yields:

From the *LRFD Manual of Steel Construction*, Table 8-8:

$$\ell_w = 4 \text{ in.}, k = \frac{2}{4} = 0.5, a = \frac{3.5}{4} = 0.875$$

Shows $C = 1.878$

$$\phi Z_n = \phi R_n = \phi(C)(C_1)(\ell_w)(D) = 0.75(1.878)(1)(4)(4)$$
$$\phi Z_n = 22.5 \text{ kip}$$

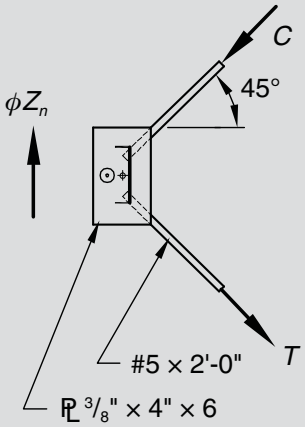
Wall plate strength:
Steel shear from Eq. 6-2:

$$\phi Z_n = \phi V_s = \phi n A_{se} F_{ut} = 0.65(4)(0.20)(65) = 33.8 \text{ kip}$$

Concrete shear: The connection is far enough from any edge and the plate is considered to fail in steel shear.

Double-tee deck plate (see previous example):

$$\phi V_n = 20.4 \text{ kip}$$



Summary:

Failure mode	Design strength, kip
Weld on erection plate	22.5
Moment in erection plate	13.9
Shear in erection plate	29.2
C-shaped weld on erection plate	22.4
Wall-plate studs steel shear	33.8
Wall-plate studs concrete shear	28.0
Double-tee deck plate	20.4

Critical $\phi Z_n = 13.9$ kip

EXAMPLE 6.13.4
Wall-to-Wall Tension Connection – Reference Section 4.5

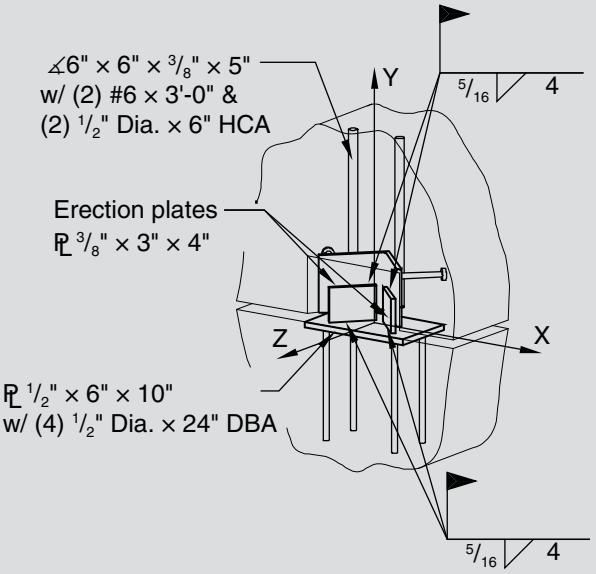
Given:

The typical wall-to-wall tension connection shown.

Wall thickness: 8 in.
Deformed bar anchors (DBA): f_y = 60 ksi
Reinforcing bar Grade 60: f_y = 60 ksi
Plates ASTM A36: F_y = 36 ksi
Weld material: E70 - plates to angle
E90 - rebar to angle
Concrete: f'_c = 5000 psi, normalweight

Problem:

Determine the tension design strength in the Y direction.



Solution:

Erection plate tension strength:

$\phi Y_n = \phi A_{pl} F_y$ = 0.9(0.375)(4)(2 plates)(36)
= 97.2 kip

Weld strength:

Erection plate to lower plate:

From Design Aid 6.14.2:

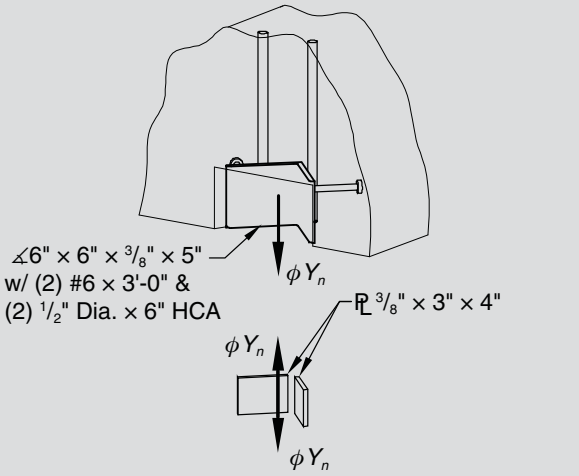
Strength of 5/16 in. fillet weld = 6.96 kip/in.

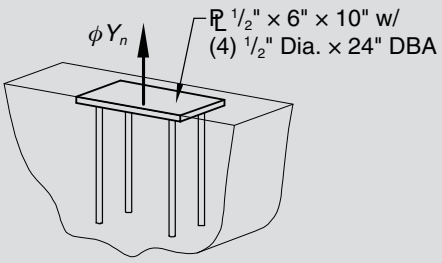
ϕY_n = 6.96(4)(2) = 55.7 kip

Erection plate to angle:

From Design Aid 6.14.2:

ϕY_n = 6.96(4)(2) = 55.7 kip





Note: Dia. = diameter; HCA = headed concrete anchor; DBA = deformed anchor bar

EXAMPLE 6.13.4

Wall-to-Wall Tension Connection – Reference Section 4.5 (cont.)

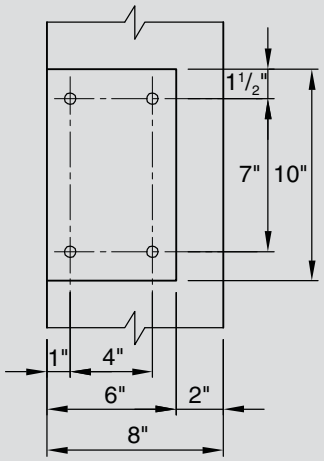
Lower plate capacity – controlled by four $^1/_2$ in. DBAs
Assume all four DBAs yield to resist applied force
$\phi Y_n = \phi A_b f_y = 0.9(0.20)\ (4)(60) = 43.2$ kip

Development length of DBA is the same as reinforcing bars.
From Design Aid 15.2.9:

Required $\ell_d = 17$ in. < 24 in. **OK**

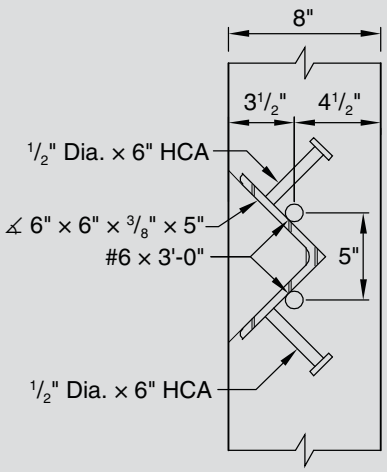
Pocket angle capacity:
Neglect headed studs, strength is controlled by #6 reinforcing bars:
$\phi Y_n = \phi A_b f_y = 0.9(2)(0.44)(60) = 47.5$ kip

From Design Aid 15.2.9:
Required length of #6 = 25 in.
Development length provided = 32 in. **OK**



Summary:

Failure mode	Design strength, kip
Weld on erection plate to lower plate	55.7
Weld on erection plate to angle	55.7
Tension in erection plate	97.2
Deformed bar anchor tension	43.2
Angle reinforcing bar	47.5



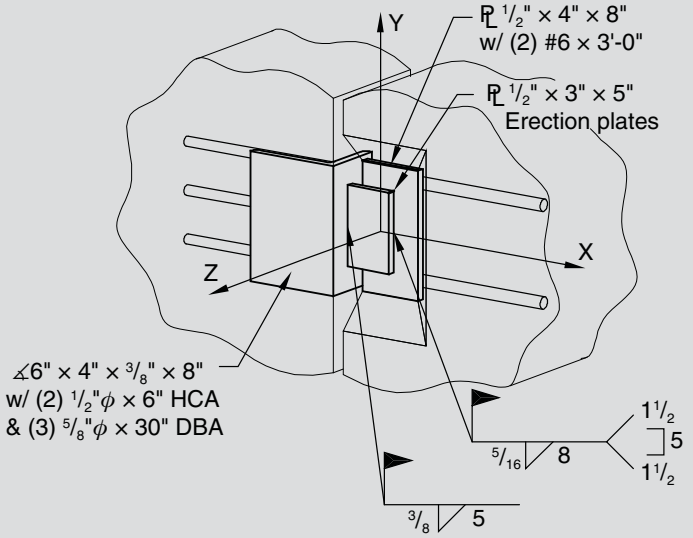
Note: It is good practice to force the failure mode into the tensile plate. This can be done by putting a hole in the erection plate or using other methods of reducing the area.

Critical $\phi Y_n = 43.2$ kip.

EXAMPLE 6.13.5
Wall-to-Wall Shear Connection – Reference Section 4.5

Given:
The typical wall-to-wall shear connection shown.
Wall thickness: 8 in.
Deformed bar anchors (DBAs): f_y = 60 ksi (see Section 6.4.5)
Headed studs (HCAs): f_{ut} = 65 ksi
Reinforcing bar Grade 60 (ASTM A706): f_y = 60 ksi, f_{ut} = 90 ksi
Plates ASTM A-36: F_y = 36 ksi
Weld material: E70 - plate to angle and plate
E80 - rebar to angle and plate
Concrete: f'_c = 5000 psi, normalweight
Connection plate is recessed 2 in.

Problem:
Determine the tension design strength in the Y direction.



Solution:
Erection plate shear strength:

$$\phi Y_n = \phi A_{pl}(0.6F_y)$$
$$= 0.9(0.5)(5)(0.6)(36)$$
$$= 48.6 \text{ kip}$$

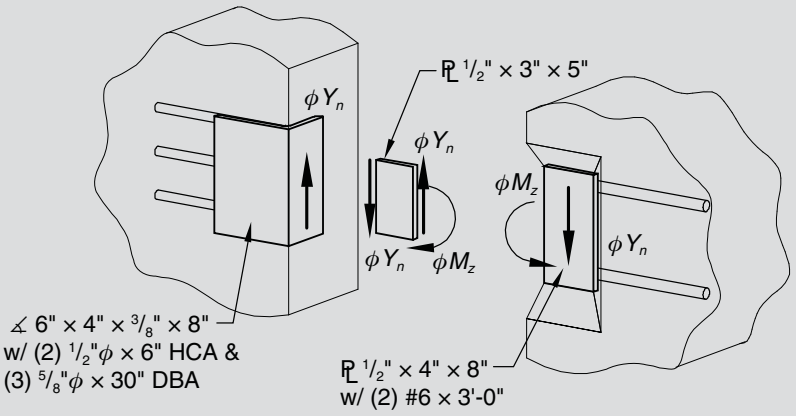
Weld strength:

Erection plate to angle (left side):
From Design Aid 6.15.2:

Strength of 3/8 in. fillet weld
= 8.35 kip/in.
ϕY_n = 8.35 (5) = 41.8 kip

Erection plate to plate with #6 (right side):

This C-shaped weld can be designed by either of the numerical methods or tabulated method of AISC. Using *LRFD Manual of Steel Construction*,13th edition, Table 8-8, yields:



$$e = a\ell \qquad k\ell = 1.5$$

$$a = \frac{e}{\ell} = \frac{2.72}{5} = 0.544 \qquad k = \frac{1.5}{5} = 0.3$$

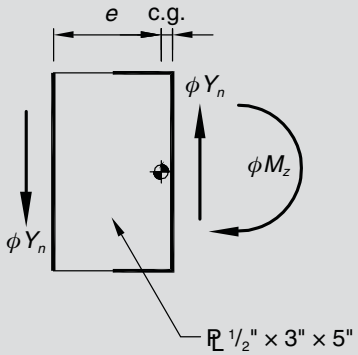
EXAMPLE 6.13.5
Wall-to-Wall Shear Connection – Reference Section 4.5 (cont.)

From AISC Table 8-8:

C = 2.025

$\phi Y_n = \phi R_n = \phi(C)(C_1)(\ell)(D) = 0.75(2.025)(1)(5)(5)$

ϕY_n = 37.9 kip



Erection-plate moment capacity (c.g. = center of gravity):

$$\text{c.g.} = \frac{2b\left(\frac{b}{2}\right)}{d+2b} = \frac{2(1.5)\left(\frac{1.5}{2}\right)}{5+2(1.5)}$$

= 0.28 in.

e = 3 – c.g. = 3 – 0.28 = 2.72 in.

$$\phi M_z = \phi F_y Z_p = \phi F_y \left(\frac{bd^2}{4}\right) = 0.9(36)\left(\frac{0.5(5)^2}{4}\right) = 101.3 \text{ kip-in.}$$

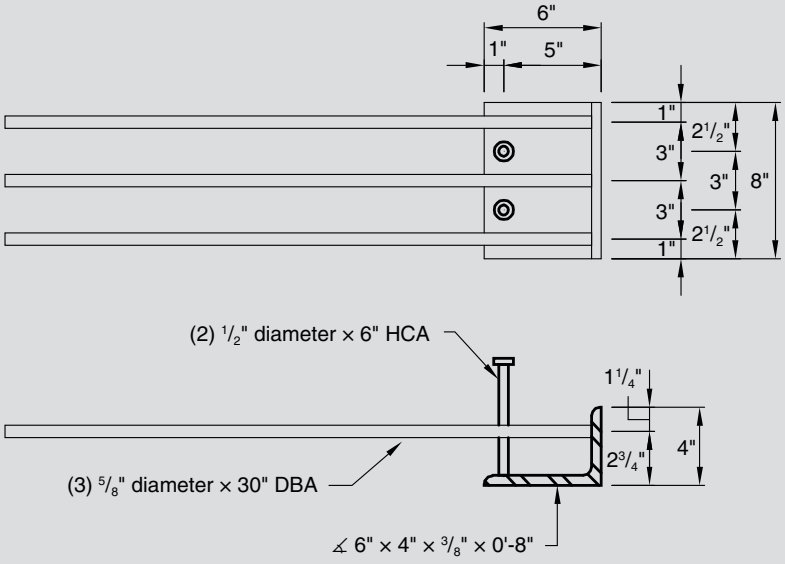
$$\phi Y_n = \frac{\phi M_z}{e} = \frac{101.25}{2.72} = 37.2 \text{ kip}$$

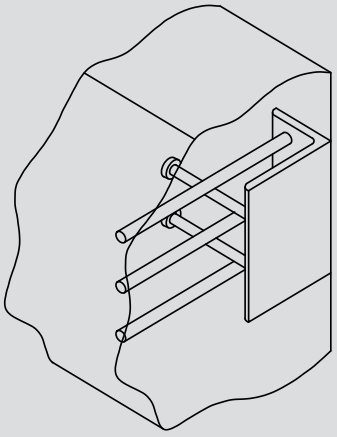
Angle capacity:

The angle strength will be controlled by the shear strength of the studs and the DBAs. Since the connection is not located near a free edge, the steel strength will govern.

From Eq. 6-2:

$\phi V_s = \phi n A_s f_y = 0.75(3)(0.31)(60) = 41.9$ kip





EXAMPLE 6.13.5
Wall-to-Wall Shear Connection – Reference Section 4.5 (cont.)

Embed plate with #6 (right side):

Steel shear strength:

Assume the bar is developed in the wall. Strength based on combined loading of steel. Moment arm d is equal to distance between reinforcing bars.

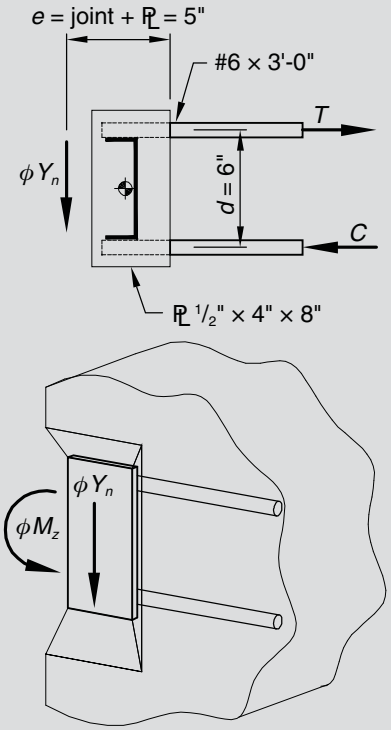
$$\frac{1}{\phi}\left[\left(\frac{V_u}{V_n}\right)^2+\left(\frac{M_u}{M_p}\right)^2\right]\le 1.0$$

$$\frac{1}{\phi}\left[\left(\frac{\phi Y_n}{0.6f_yA_{rb}}\right)^2+\left(\frac{\phi Y_n e}{f_yA_{rb}d}\right)^2\right]\le 1.0$$

$$\frac{1}{0.9}\left[\left(\frac{\phi Y_n}{0.6(60)(2)(0.44)}\right)^2+\left(\frac{\phi Y_n(5)}{60(0.44)(6)}\right)^2\right]\le 1.0$$

$$\phi Y_n^2\left[\left(\frac{1}{31.68}\right)^2+\left(\frac{5}{158.4}\right)^2\right]\le 0.9$$

$\phi Y_n^2\ (0.0020) \le 0.9$
$\phi Y_n = 21.2$ kip



Summary:

Failure mode	Design strength, kip
Weld on erection plate	41.8
Moment of erection plate	37.2
Shear of erection plate	48.6
C-shaped weld on erection plate	37.9
Deformed bar anchor	41.9
Wall-plate reinforcing bars	21.2

Critical: $\phi Y_n = 21.2$ kip.

EXAMPLE 6.13.5
Wall-to-Wall Shear Connection – Reference Section 4.5 (cont.)

Check side-edge capacity per Section 6.5.5.3.

Basic capacity (DBAs control with closer d_{e1}):

$V_{co1} = 87\lambda\sqrt{f'_c}\,(d_{e1})^{1.33}(d)^{0.75}$

$= 87(1.0)\sqrt{5000}\,(2.75)^{1.33}(0.625)^{0.75}$

$= 16{,}655$ lb $= 16.66$ kip

$\phi V_{co1} = (0.75)(16.66) = 12.5$ kip

$C_{x1} = 1.0$

C_{y1} factor

$n_y = 3;\ Y = 6$ in.

$$C_{Y1} = \frac{(n,Y)^{0.25}}{0.6d_{e1}} + 0.15 \le n_y$$

$$= \frac{[3(6)]^{0.25}}{0.6(2.75)} + 0.15 \le 3$$

$= 1.4$

$C_{ev1} = 1.0$ no eccentricity

$C_{vcr} = 1.0$

$\phi V_{c1} = \phi V_{co1}(C_{x1})(C_{y1})(C_{ev1})(C_{vcr})$

$= (12.5)(1.0)(1.4)(1.0)(1.0)$

$= 17.5$ kip

Basic capacity – studs:

$$V_{co1} = 87(1.0)\sqrt{5000}\,(5)^{1.33}(0.5)^{0.75}\left(\frac{1}{1000}\right)$$

$= 31.1$ kip

$\phi V_{co1} = (0.75)(31.1) = 23.3$ kip

$C_{x1} = 1.0$

C_{y1} factor

$n_y = 2;\ Y = 3$ in.

$$C_{Y1} = \frac{[2(3)]^{0.25}}{0.6(5)} + 0.15 \le 2$$

$= 0.67$

$C_{ev1} = 1.0$ no eccentricity

$C_{vcr} = 1.0$ no cracking at this stage

$\phi V_{c1} = \phi V_{co1}(C_{x1})(C_{y1})(C_{ev1})(C_{vcr})$

$= (23.3)(1.0)(0.67)(1.0)(1.0)$

$= 15.6$ kip

EXAMPLE 6.13.5
Wall-to-Wall Shear Connection – Reference Section 4.5 (cont.)

$\phi V_s = \phi(n)(A_s f_{ut}) = (0.65)(2)(0.2)(65)$

$= 16.9$ kip

Development length of a #5:

$f_y = 60$
$\Psi_t = 1.0$
$\Psi_e = 1.0$
$\lambda = 1.0$

$$\ell_d = \left(\frac{f_y \psi_t \psi_e \lambda}{25\sqrt{f'_c}}\right) d_b$$

$$= \left(\frac{60{,}000(1.0)(1.0)(1.0)}{25\sqrt{5000}}\right) 0.625$$

$= 21.2$ in.; actual length = 30 in.

The #5 will be developed beyond any postulated failure surface. Thus, the three $^5/_8$ in. diameter × 2 ft-6 in. DBAs will control capacity after cracking (ACI 318-05, RD.4.2.1)

Thus:

$\phi V_s = \phi n A_s f_y = (0.65)(3)(0.31)(60)$

$= 36.3$ kip

where:

$\phi = 0.65$ for shear (dowel action)

SEVENTH EDITION

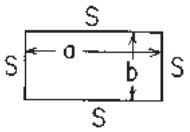
ROARK'S FORMULAS FOR STRESS AND STRAIN

Warren C. Young

Richard G. Budynas

TABLE 11.4 Formulas for flat plates with straight boundaries and constant thickness

NOTATION: The notation for Table 11.2 applies with the following modifications: a and b refer to plate dimensions, and when used as subscripts for stress, they refer to the stresses in directions parallel to the sides a and b, respectively. σ is a bending stress which is positive when tensile on the bottom and compressive on the top if loadings are considered vertically downward. R is the reaction force per unit length normal to the plate surface exerted by the boundary support on the edge of the plate. r'_o is the equivalent radius of contact for a load concentrated on a very small area and is given by $r'_o = \sqrt{1.6r_o^2 + t^2} - 0.675t$ if $r_o < 0.5t$ and $r'_o = r_o$ if $r_o \geqslant 0.5t$

Case no., shape, and supports	Case no., loading	Formulas and tabulated specific values
1. Rectangular plate; all edges simply supported 	1a. Uniform over entire plate	(At center) $\sigma_{max} = \sigma_b = \dfrac{\beta q b^2}{t^2}$ and $y_{max} = \dfrac{-\alpha q b^4}{Et^3}$ (At center of long sides) $R_{max} = \gamma q b$

a/b	1.0	1.2	1.4	1.6	1.8	2.0	3.0	4.0	5.0	∞
β	0.2874	0.3762	0.4530	0.5172	0.5688	0.6102	0.7134	0.7410	0.7476	0.7500
α	0.0444	0.0616	0.0770	0.0906	0.1017	0.1110	0.1335	0.1400	0.1417	0.1421
γ	0.420	0.455	0.478	0.491	0.499	0.503	0.505	0.502	0.501	0.500

(Ref. 21 for $\nu = 0.3$)

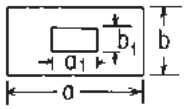
	1b. Uniform over small concentric circle of radius r_o (note definition of r'_o)	(At center) $\sigma_{max} = \dfrac{3W}{2\pi t^2}\left[(1+\nu)\ln\dfrac{2b}{\pi r'_o} + \beta\right]$ $y_{max} = \dfrac{-\alpha W b^2}{Et^3}$

a/b	1.0	1.2	1.4	1.6	1.8	2.0	∞
β	0.435	0.650	0.789	0.875	0.927	0.958	1.000
α	0.1267	0.1478	0.1621	0.1715	0.1770	0.1805	0.1851

(Ref. 21 for $\nu = 0.3$)

TABLE 11.4 Formulas for flat plates with straight boundaries and constant thickness (*Continued*)

1c. Uniform over central rectangular area

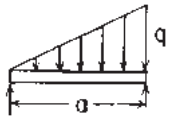


(At center) $\sigma_{max} = \sigma_b = \dfrac{\beta W}{t^2}$ where $W = qa_1b_1$

a_1/b / b_1/b	$a = b$						$a = 1.4b$						$a = 2b$					
	0	0.2	0.4	0.6	0.8	1.0	0	0.2	0.4	0.8	1.2	1.4	0	0.4	0.8	1.2	1.6	2.0
0		1.82	1.38	1.12	0.93	0.76		2.0	1.55	1.12	0.84	0.75		1.64	1.20	0.97	0.78	0.64
0.2	1.82	1.28	1.08	0.90	0.76	0.63	1.78	1.43	1.23	0.95	0.74	0.64	1.73	1.31	1.03	0.84	0.68	0.57
0.4	1.39	1.07	0.84	0.72	0.62	0.52	1.39	1.13	1.00	0.80	0.62	0.55	1.32	1.08	0.88	0.74	0.60	0.50
0.6	1.12	0.90	0.72	0.60	0.52	0.43	1.10	0.91	0.82	0.68	0.53	0.47	1.04	0.90	0.76	0.64	0.54	0.44
0.8	0.92	0.76	0.62	0.51	0.42	0.36	0.90	0.76	0.68	0.57	0.45	0.40	0.87	0.76	0.63	0.54	0.44	0.38
1.0	0.76	0.63	0.52	0.42	0.35	0.30	0.75	0.62	0.57	0.47	0.38	0.33	0.71	0.61	0.53	0.45	0.38	0.30

(Values from charts of Ref. 8; $\nu = 0.3$.)

1d. Uniformly increasing along length



$\sigma_{max} = \dfrac{\beta q b^2}{t^2}$ and $y_{max} = \dfrac{-\alpha q b^4}{Et^3}$

a/b	1	1.5	2.0	2.5	3.0	3.5	4.0
β	0.16	0.26	0.34	0.38	0.43	0.47	0.49
α	0.022	0.043	0.060	0.070	0.078	0.086	0.091

(Values from charts of Ref. 8; $\nu = 0.3$.)

1e. Uniformly increasing along width

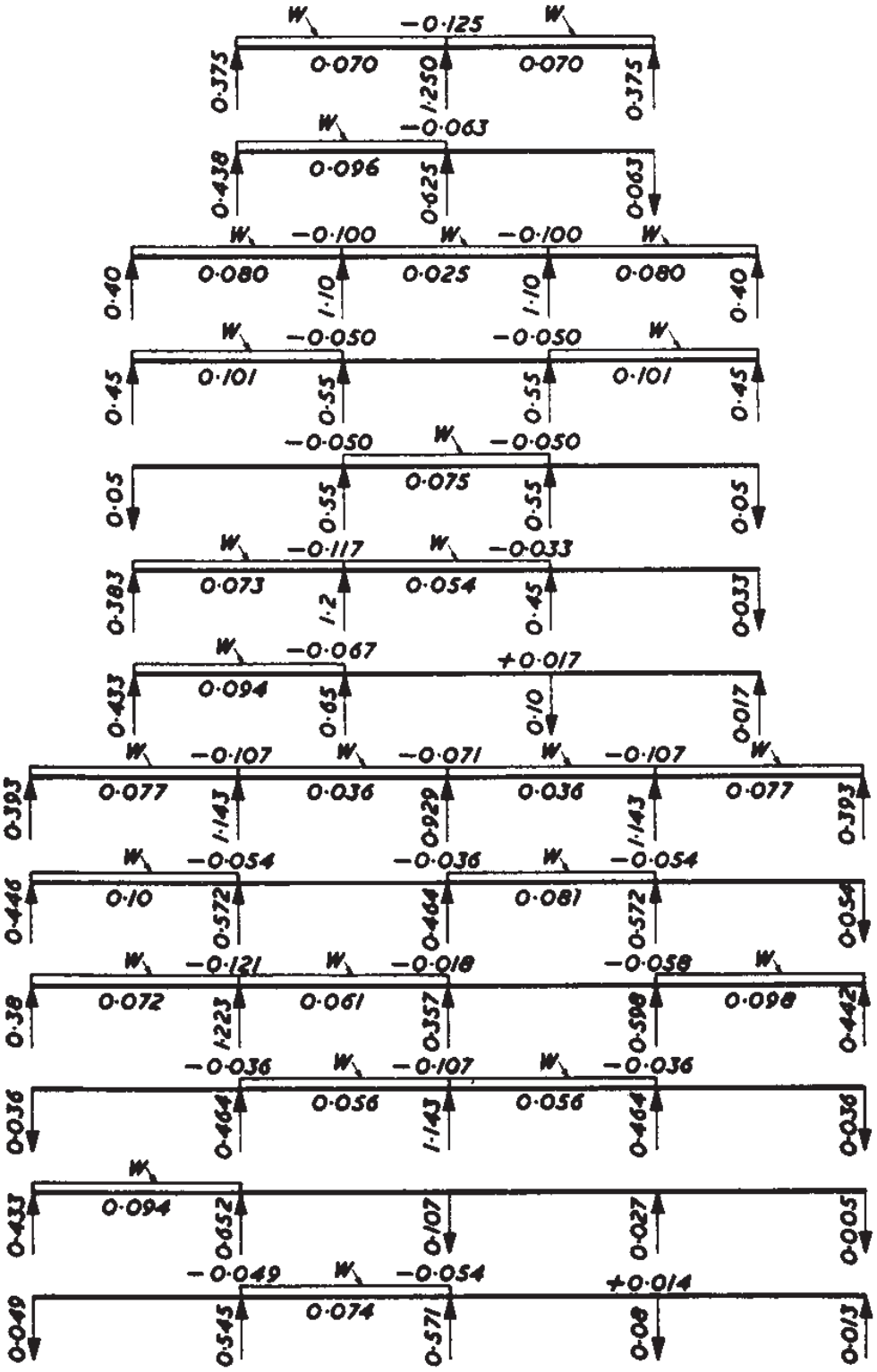
$\sigma_{max} = \dfrac{\beta q b^2}{t^2}$ and $y_{max} = \dfrac{-\alpha q b^4}{Et^3}$

a/b	1	1.5	2.0	2.5	3.0	3.5	4.0
β	0.16	0.26	0.32	0.35	0.37	0.38	0.38
α	0.022	0.042	0.056	0.063	0.067	0.069	0.070

(Values from charts of Ref. 8; $\nu = 0.3$.)

EQUAL SPAN CONTINUOUS BEAMS
UNIFORMLY DISTRIBUTED LOADS

Moment = coefficient x W x L
Reaction = coefficient x W
where W is the U.D.L. on one span only and L is one span



STRUCTURAL STEEL DESIGNER'S HANDBOOK

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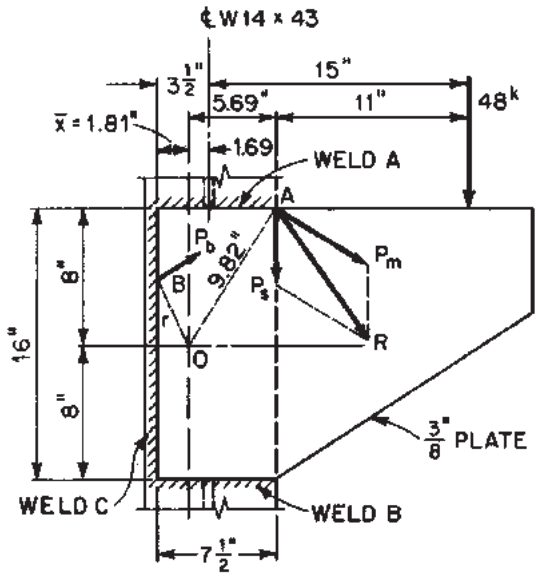

FIGURE 5.47 Bracket with fillet welds in shear.

The resisting moment per inch of weld is proportional to the square of the distance from O.

The applied moment equals the total resisting moment, the sum of the resisting moments of all the welds in the group.

These consequences result in the relationship

$$P_m = \frac{Mc}{J} \quad \text{or} \quad M = \frac{P_m J}{c} \tag{5.16}$$

where M = applied moment, in-kips
P_m = load due to M on the point of a weld most distant from the center of gravity of the weld group, kips per in
J = sum of squares of distances of unit weld lengths from center of gravity of group, in^3 (analogous to polar moment of inertia)
c = distance of outermost point from center of gravity, in

Hence, when the moment applied to a weld group is known, the maximum stress in the welds can be computed from Eq. (5.16). This stress has to be added vectorially to the shear on the weld. The resultant stress must be less than the allowable capacity of the weld.

Depending on the weld pattern, the largest resultant stress does not necessarily occur at the outermost point of the weld group. Vectorial addition of shear and bending stresses may have to be performed for the most critical points in a group to determine the maximum.

Computation of weld stresses generally is simplified if the forces and distances are resolved into their horizontal and vertical components. Advantage can be taken of the fact that

$$J = I_x + I_y \tag{5.17}$$

where I_y = sum of squares of distances measured horizontally from center of gravity of weld group to unit lengths of welds, in^3
I_x = sum of squares of distances measured vertically from center of gravity of weld group to unit lengths of welds, in^3

I_x and I_y are analogous to moment of inertia.

Example—Welded Bracket Connection—AISC LRFD. Investigate the bracket connection in Fig. 5.47. The A36 steel bracket is to be connected with fillet welds made with E70XX electrodes to a building column. The bracket carries a 48-kip factored load 15 in from the center of the column web.

Elastic Method. Because of symmetry, the center of gravity$O$ of the weld group is located vertically halfway between top and bottom of the 16-in-deep plate. The horizontal location of O relative to the vertical weld is obtained by dividing the moments of the weld lengths about the vertical weld by the total length of welds:

$$\bar{x} = \frac{2 \times 7.5 \times 7.5/2}{2 \times 7.5 + 16} = \frac{56.2}{31} = 1.81 \text{ in}$$

J is obtained from Eq. (5.17):

Welds A and B: $2 \times 7.5(8)^2 = 961$ Welds A and B: $\dfrac{2(7.5)^3}{12} = 70$

Weld C: $\dfrac{(16)^3}{12} = \underline{341}$ $2 \times 7.5\left(\dfrac{7.5}{2} - 1.81\right)^2 = 56$

$I_x = 1302 \text{ in}^3$ Weld C: $16(1.81)^2 = \underline{53}$

$I_y = 179 \text{ in}^3$

$$J = 1301 + 179 = 1480 \text{ in}^3$$

By Eq. (5.16), the stress on the most distant point A in the weld group due to moment is

$$P_m = \frac{48(15 + 1.69)9.82}{1480} = 5.32 \text{ kips per in}$$

The vertical component of this load is

$$P_v = \frac{5.32 \times 5.69}{9.82} = 3.08 \text{ kips per in}$$

And the horizontal component is

$$P_h = \frac{5.32 \times 8}{9.82} = 4.33 \text{ kips per in}$$

The shear load on the welds is $48/(2 \times 7.5 + 16) = 1.55$ kips per in. Consequently, the total load on the outermost point is the resultant is

$$R = \sqrt{(1.55 + 3.08)^2 + (4.33)^2} = 6.34 \text{ kips per in}$$

For a design stress of $0.75 \times 0.60 \times 70 = 31.5$ ksi, the weld size required is

$$D = \frac{6.34}{0.707 \times 31.5} = 0.285 \text{ in}$$

Use a $\frac{5}{16}$-in weld.

Instead of the elastic method, the following inelastic method based on the instantaneous center of rotation can be used. The tables for eccentrically loaded weld groups in the AISC manuals—ASD and LRFD—are based on this method.

PROPERTIES OF GRADE 8.8 BOLT & NUT (ISO)

BOLT SIZE	PITCH	STRESS AREA MM2	BOLT/STUD/SCREW ISO 898-1 Gr.8.8						NUT ISO 898-2 Gr.8		
			PROOF STRESS N/MM2	PROOF LOAD KN	TENSILE STRESS N/MM2	TOUR-QUE* N-m	HARD-NESS HRC	ELONGA-TION# %	PROOF STRESS N/MM2	PROOF LOAD KN	HARD-NESS HRC
M6	1	20.1	580	11.7	800.0	9.4	22-32	12.0	855	17.2	30 Max
M8	1.25	36.6	580	21.2	800.0	22.8	22-32	12.0	870	31.8	30 Max
M10	1.5	58.8	580	34.1	800.0	45.8	22-32	12.0	880	51.7	30 Max
M12	1.75	84.3	580	48.9	800.0	78.8	22-32	12.0	880	74.2	38 Max
M14	2.0	115.0	580	66.7	800.0	125.4	22-32	12.0	880	101.2	38 Max
M16	2.0	157.0	580	91.1	800.0	195.6	22-32	12.0	920	144.4	38 Max
M18	2.5	192.0	600	115.2	830.0	278.4	23-34	12.0	920	176.6	38 Max
M20	2.5	245.0	600	147.0	830.0	394.7	23-34	12.0	920	225.4	38 Max
M22	2.5	303.0	600	181.8	830.0	536.9	23-34	12.0	920	278.8	38 Max
M24	3.0	353.0	600	211.8	830.0	682.4	23-34	12.0	920	324.8	38 Max
M27	3.0	459.0	600	275.4	830.0	998.3	23-34	12.0	920	422.3	38 Max
M30	3.5	561.0	600	336.6	830.0	1,356	23-34	12.0	920	516.1	38 Max
M33	3.5	694.0	600	416.4	830.0	1,845	23-34	12.0	920	638.5	38 Max
M36	4.0	817.0	600	490.2	830.0	2,369	23-34	12.0	920	751.6	38 Max
M39	4.0	976.0	600	585.6	830.0	3,066	23-34	12.0	920	897.9	38 Max
M42	4.5	1,120.0	600	672.0	830.0	3,789	23-34	12.0	920	1,030.4	38 Max
M45	4.5	1,310.0	600	786.0	830.0	4,748	23-34	12.0	920	1,205.2	38 Max
M48	5.0	1,470.0	600	882.0	830.0	5,684	23-34	12.0	920	1,352.4	38 Max
M52	5.0	1,760.0	600	1,056.0	830.0	7,732	23-34	12.0	920	1,619.2	38 Max
M56	5.5	2,030.0	600	1,218.0	830.0	9,157	23-34	12.0	920	1,867.6	38 Max
M60	5.5	2,360.0	600	1,416.0	830.0	11,406	23-34	12.0	920	2,171.2	38 Max
M64	6.0	2,680.0	600	1,608.0	830.0	13,816	23-34	12.0	920	2,465.6	38 Max
M68	6.0	3.060.0	600	1,836.0	830.0	16,761	23-34	12.0	920	2,815.2	38 Max
M72	6.0	3,460.0	600	2,076.0	830.0	20,067	23-34	12.0	920	3,183.2	38 Max

DIMENSIONS	NORMAL HEX	NORMAL HEX
MARKINGS	'RS' 'M' '8.8'	'RS' '8.8'
CARBON	0.25-0.55	-0.58
MANAGENESE	-0.25	
SULPHUR	-0.035	-0.15
SILICON		
CHROMIUM		
MOLYDENUM		
NICKLE		
VANADIUM		
BORON	-0.003	
PHOSPHOROUS	-0.035	-0.06
MATERIAL	Carbon steel quenched & tempered	Medium Carbon Steel

NOTES:
Left hand side of '-' is minimum value
Right hand side of '-' is maximum value
Eg. 0.5 - 0.7 min. is 0.5 and max is 0.7
Eg. -0.8 max is 0.8 no minimum value
Eg. 2.0- min. is 2.0 no maximum value

* Torque value based on 75% of proof load and finish as recieved steel